A RATIONALE FOR DETERMINING LOUISIANA'S COASTAL ZONE

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Coastal
Resources
Program

STATE PLANNING OFFICE

IN COOPERATION WITH

LOUISIANA WILDLIFE AND FISHERIES COMMISSION

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A RATIONALE FOR DETERMINING LOUISIANA'S COASTAL ZONE

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LOUISIANA SEAGRANT

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Introduction

The Coastal Zone Management Act of 1972 directed coastal states to develop, with the assistance of the federal government, programs for managing the resources of their respective coastal regions. Louisiana received federal and matching state funding under the Act in 1974, and the Louisiana Coastal Resources Program was initiated to develop coastal management policy for the state. The State Planning Office administers the Coastal Resources Program in cooperation with the Louisiana Wildlife and Fisheries Commission, the Louisiana Coastal Commission, and the Louisiana Sea Grant Program.

An essential aspect of the initial phases of this program is determination of the boundaries of the area to be included within the management plan's jurisdiction. The Act provides guidelines for determining the criteria to be used in formulating these boundaries. The Coastal Zone Management area (hereafter termed "Coastal Zone" in this report) should include coastal waters and shorelines and should extend inland to the extent necessary to control activities on shorelands which have a direct and significant impact on coastal waters.

The vastness of Louisiana's coastal wetlands, flood plains, and estuaries makes Coastal Zone boundary delineation an interesting and complex problem. This report presents relevant information and provides a rationale for eventual boundary delineation. While a preliminary best-fit boundary line is included, the primary purpose of this report is to provide a compendium of data which will be useful in making the final boundary decision. Criteria for boundary delineation are presented on the basis of legal/governmental and biophysical considerations.

The legal/governmental aspects of the Coastal Zone boundary are discussed from the perspective of possible lateral, seaward, and inland boundaries. The lateral and seaward boundaries are generally considered coextensive with the state's external political boundaries. Included in the discussion of the inland boundary are federal regulatory boundaries under the U.S. Constitution's commerce clause, the limits of admiralty jurisdiction, the 100-year flood elevation line, and the storm surge reference line. Also discussed are the criteria for the inland boundary required by the Coastal Zone Management Act, the United States Constitution, and State law. These considerations are discussed briefly in the section summarizing legal/governmental criteria, with more detailed information presented in Appendices 1-4.

Biophysical aspects of the Coastal Zone boundary are discussed only from the perspective of inland boundary determination. Analyses of applicable biophysical parameters are based on availability of data and the relevance of these data to boundary delineation. Data deficiencies exist in most categories, and data that are available are restricted by their resolution, quality, location, and record length. Some parameters were completely excluded due to inadequacy of information. The parameters that were selected are grouped into two general categories, those which are regional and correlate with topography generally trending in an east-west direction, and those which are based on point locations but show regional patterns either up stream basins or in an east-west direction.

The selected list includes:

Regional Topographic Correlative Criteria:

- Geology - Pleistocene/Recent contact
- Elevation - 5 and 25-foot contours
- Soils - wetland/non-wetland boundary
- Vegetation - wetland/non-wetland boundary
- One hundred year flood and tidal inundation level

Point Location Correlative Criteria:

- Salinity - inland intrusion
- Occurrence of *Rangia cuneata* (brackish water clam)

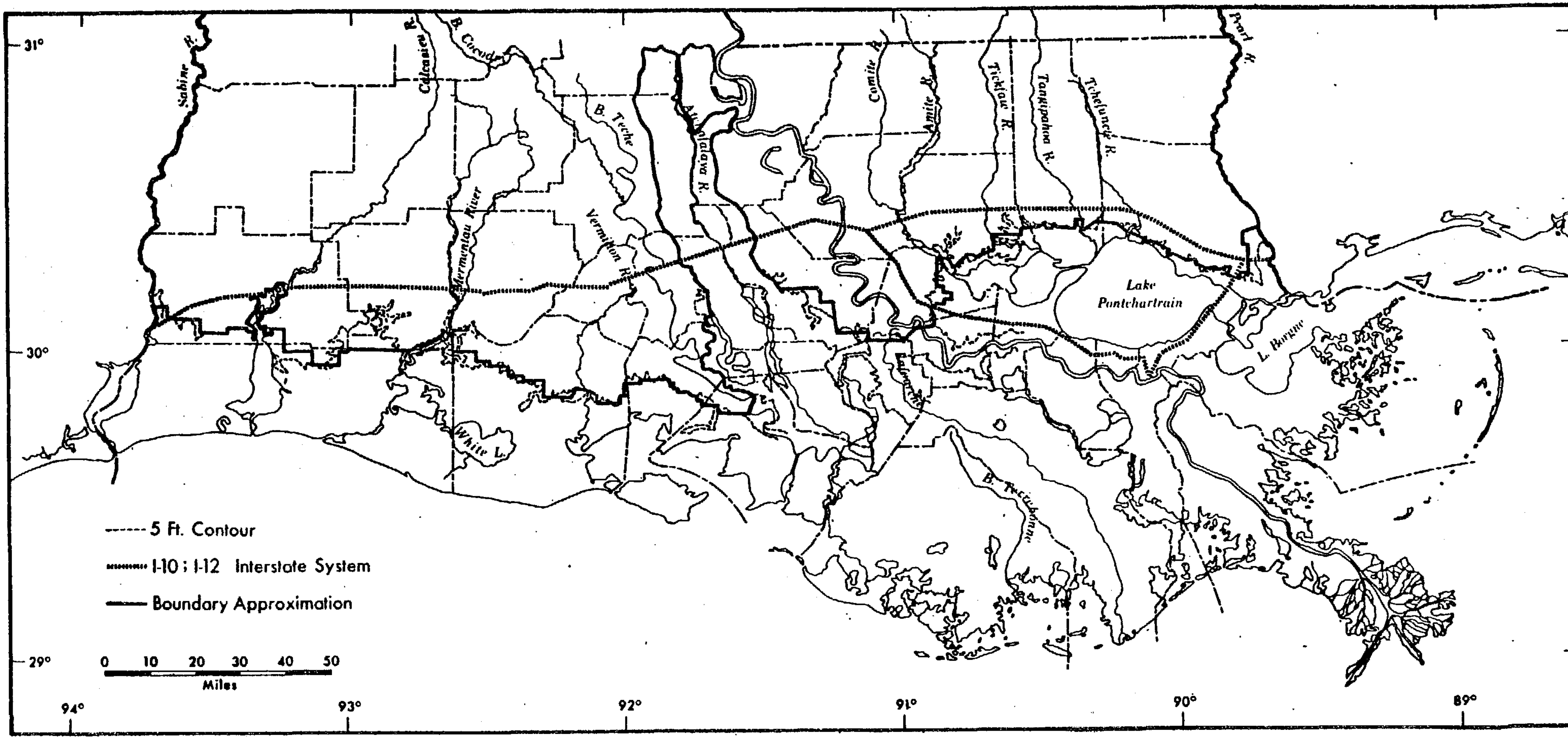


Figure 1. Preliminary Coastal Zone inland boundary approximating best fit between biophysical parameters and legally definable entities depicted on 7.5 and 15 minute quadrangle maps. Twenty-one biophysical parameters were evaluated to determine if there was any one pervasive factor controlling the distribution of any or all of the others. Best-fit correlations pointed to the line of Pleistocene/Recent contact, which is approximated by the 5-foot contour line.

flood and tidal zones are not included within the Coastal Zone. This is because these hazards occur infrequently and do not permanently alter the primary characteristics of soil, vegetation, geology, and elevation.

2) Recent studies of primary productivity in swamp environments show that fresh water detritus (decayed vegetation and attached microorganisms) is a vital contributor to marine ecosystems and exists far inland up river basins. Therefore, an inland limit should at least include the zone up the river basins in which pulses of marine water are a normal occurrence. ?

3) Interviews with residents along the Sabine, Atchafalaya, Calcasieu, Mermentau, Pearl, and Tchefuncta Rivers and along Bayou Lacombe indicate that the perceptions of residents as to their "coastal relatedness" correlate well with salinity measurements and the presence of marine organisms.

4) The Atchafalaya Floodway from Simmesport to Morgan City and between the east and west protection levees is considered one integrated unit and is not divided into coastal or non-coastal sections. This unit clearly extends to Simmesport and contributes significantly to the nutrient input into central Louisiana coastal waters; its lower portion still acts as an interacting basin between marine and fresh waters. From a biophysical viewpoint, the basin should be included in the Coastal Zone. Since this area is subject to existing pervasive management programs at the federal and state level, it may require special considerations from the legal/governmental standpoint.

5) Consideration of the extent of shoreline development along streams entering the coastal region, extending laterally to the 5-foot contour line, is used to help determine the inland limit of the stream basin for coastal management purposes.

6) Where the limits of a town or city come close to the 5-foot contour line, these areas are included in the Coastal Zone because of the expectation that pressures for further development into wetland areas will proceed from these towns. Such development should be part of a coastal management program.

looking at human factor

7) Throughout the delineation of the Coastal Zone inland boundary, land features were sought which closely approximate the 5-foot contour line. The features chosen were those which have been surveyed and which can be easily described. Land owners should be able to easily identify those lands included in the Coastal Zone. Features used include Range and Township lines, boundaries between parishes, refuge boundaries, pipeline corridors, canals, railroad rights-of-way, roads, etc.

8) Included within the Coastal Zone are high-ground geologic features which are important to the coastal region but which cannot be characterized as wetland. These include cheniers, natural levees, salt domes, constructed levees and fills, "fast lands" surrounded by levees, and some fringes and outlying "islands" of the Pleistocene Terrace which are surrounded by wetlands. These areas should be part of the Coastal Zone, but management principles sensitive to their nonwetland character should be considered in the overall management program.

Non-wetland areas in Coastal Zone

The final result of these investigations is a preliminary best-fit line which was drawn to approximate the position of the Pleistocene/Recent contact line as it is depicted by the 5-foot contour and which correlates closely with other biophysical and socio-governmental criteria (Figure 1). ~~This line should be considered only as a working~~ baseline derived from the ~~criteria as~~ stated and from which a hard ~~boundary may~~ evolve. Additional details and data supporting the illustrated biophysical information are available. Legal/governmental and biophysical parameter criteria are summarized in the next two sections, with the following appendices presenting more detailed information.

result of erosion and accretion. However, the Court reasoned that any inconvenience caused by an ambulatory coast could be resolved by legislation or agreement between the concerned parties.

Additional information on lateral and seaward boundaries can be found in Appendix 1.

INLAND BOUNDARY

Three possible criteria for designation of a Coastal Zone inland boundary are considered. They are "navigable water[s] of the United States," the 100-year flood elevation line, and the storm surge reference line. In addition, the requirements of the federal Coastal Zone Management Act, federal and state constitutions, and state law are discussed with respect to Coastal Zone inland boundary delineation.

Navigable Waters of the United States

The United States Constitution does not mention "navigable water[s] of the United States," but this concept has been used to define the extent of federal jurisdiction under both the Commerce and Admiralty Clauses of the Constitution. Traditionally, the term has been thought to mean the same in both contexts. Federal jurisdiction extends to the ordinary high water mark of all navigable waters of the United States (mean high tide in tidal areas).

"Navigable water[s]" are all waters that are in fact navigable, regardless of whether they are influenced by the tide, are landlocked or open, or are saline or fresh. Waters are navigable when they are, in their ordinary condition, used or susceptible of use as highways for commerce, over which trade and travel are or may be conducted in the customary modes of trade and travel on water. The test of navigability does not depend on the difficulties attending navigation. Navigability is not destroyed because the watercourse is interrupted by occasional obstructions nor need the navigation be open at all seasons of the year or at all stages of the water. It includes waters which were once navigable in fact but which are no longer, and waters which are not now navigable but which may be made navigable through reasonable improvements.

"Navigable water[s] of the United States," as opposed to navigable waters of states, are waters which form in their ordinary condition by themselves, or by uniting with other waters, a continued highway over which commerce is or may be carried on with other states or foreign nations.

The definition of "navigable waters" contained in the Federal Water Pollution Control Act amendments of 1972, raised questions concerning the Corps of Engineers jurisdiction under that act. The amendments defined "navigable waters" to mean "waters of the United States." The Environmental Protection Agency (EPA) believes, and the Federal District Court for the District of Columbia agreed, that by using the term "waters of the United States" Congress intended to eliminate the requirement of navigability for jurisdiction under that act. For purposes of pollution control and review of dredged spoil disposal the EPA has defined waters of the United States to include:

1) All navigable waters of the United States;

2) Tributaries of navigable waters of the United States;

3) Interstate waters;

4) Intrastate lakes, rivers, and streams which are utilized by interstate travelers for recreational or other purposes;

5) Intrastate lakes, rivers, and streams from which fish or shellfish are taken and sold in interstate commerce; and

6) Intrastate lakes, rivers, and streams which are utilized for industrial purposes by industries in interstate commerce.

"Navigable water[s] of the United States," as defined under the Commerce and Admiralty Clauses of the Constitution, would provide jurisdiction over coastal waters to the ordinary high water mark or the mean high tide mark. "Navigable waters," as defined in the Federal Water Pollution Control Act, would extend this boundary further shoreward. However, neither definition would extend shoreward far enough to meet the requirements of the Coastal Zone Management Act. Section 304(a) (16 U.S.C. 1453(a)) of the Act provides that the Coastal Zone shall extend inland from the shoreline "to the extent necessary to control <u>shorelands</u>, the uses of which have a direct and significant impact on coastal waters" (emphasis added). Thus, shorelands the uses of which would be subject to the Coastal Zone Management Act would not be

State Law Requirements

The degree of specificity with which the Coastal Zone boundary must be drawn depends on whether the penalties imposed will be civil or criminal in nature.

A civil boundary is not required to be described with the particularity of a deed. However, the boundary should be described with such certainty as to make it possible to determine the precise area to be included within its limits. Generally, the description of a civil boundary is sufficient if the boundary can be made certain. Where a civil boundary in a statute cannot be literally applied because of an inaccuracy, the courts will give it a reasonable construction to carry out the intent of the legislature.

A boundary containing penal sanctions must, however, be given a strict construction. It will not be extended to persons, things, or acts not within its descriptive terms. Consequently, a boundary which will contain penal sanctions must clearly prescribe the area included within its limits. Areas or uses not plainly within a Coastal Zone Management boundary containing penal sanctions will be regarded as outside the management program. The rule has been expanded to include statutes which are not strictly criminal, but "criminal in nature," such as those providing for the revocation of a license.

Miscellaneous Inland Boundary Considerations

It has already been noted that the seaward and lateral boundaries of the state, if chosen as boundaries of the Coastal Zone, will by nature be ambulatory. However, whatever inland boundary is chosen should be a relatively permanent feature (i.e. existing political boundary, railroad, canal, interstate highway). It should also enable the public to easily recognize what areas are included within the Coastal Zone, and what areas are excluded.

The boundary should be drawn broad enough to include shorelands which have "existing, projected, and potential uses" having a direct and significant impact on coastal waters. The federal regulations provide that once an application is approved <u>all</u> amendments must be submitted to the Secretary of commerce for approval prior to the initiation of the contemplated change.

Summary of Biophysical Parameter Criteria

GEOLOGY - PLEISTOCENE/RECENT CONTACT

The line of contact between the Pleistocene Terrace and the Recent marsh, swamp, and flood plain deposits is the major factor delineating coastal from non-coastal features and wetland from non-wetland features in the Louisiana coastal region. Pleistocene Terraces represent uplifted, weathered deposits produced by processes now operative in the marine and fluvial environments of coastal Louisiana. Regional tilting causes these terraces to slope gently seaward and submerge beneath onlapping Recent deposits along the Pleistocene/Recent boundary. A topographic break in slope occurs at this contact which generally trends in an east-west direction across the state between river basins and north-south along basin corridors. This line of contact is depicted in Figure 2 (p. 31); additional information is presented in Appendix 5. The line of contact is helpful in defining the distinction between coastal and non-coastal and wetland and non-wetland characteristics. It is also useful as a basis for comparing the relevance of other delineating criteria.

ELEVATION - 5 AND 25-FOOT CONTOURS

The 5 and 25-foot (1.5 and 7.5 meter) contour lines were drawn on a chart of southern Louisiana from data derived from official maps at the scale of 1:24,000 and 1:62,000 (Figure 3; p. 35). These contour lines generally trend in an east-west direction but extend north-south up river basins. The contours are highly irregular as they follow local relief, but the 5-foot contour generally follows the line of Pleistocene/Recent contact (see Appendix 6).

SOILS - WETLAND/NON-WETLAND BOUNDARY

The boundaries between wetland soils, non-wetland soils, and transitional soils were plotted on a chart of southern Louisiana are included in Appendix 14.

BIRDS - COASTAL HIATUS OF SPRING TRANS-GULF MIGRATION

Virtually every day between April 15 and May 15, large scale trans-Gulf flights consisting of a variety of species of birds arrive on the northern Gulf coast. With fair weather (about 80 percent of the time) the majority of these birds overfly the 25 to 30 mile (40 to 48 kilometer) width of the coastal marshes and alight in inland forested areas. This landing pattern is visible and has been quantified on WSR-57 weather radars at New Orleans and Lake Charles. These data have been used in developing Figure 17 (p. 89).

Birds are apparently able to select appropriate habitat while aloft, and the collective response of a number of species will give an indication of coastal/inland boundaries as reflected by forest vegetation (see Appendix 15).

SUMMARY

The biophysical information when considered from both regional and point distributions reveals the significance of topography as a parameter control for separating wetland from non-wetland habitats. The 5-foot contour line which lies in close proximity to the line of Pleistocene/Recent contact provides the most detailed information presently available for across-state correlation. Specific location of this line on the ground is accomplished through utilization of surveyed man-made features. These include roads, canals, railroads, land survey controls (such as Range and Township lines), and political boundaries. The best-fit line on Figure 1 was determined by choosing surveyed lines or reference points which lie in close proximity to the 5-foot contour and the line of Pleistocene/Recent contact. Compatibility of legal and governmental concerns with these criteria constitutes additional considerations prior to boundary delineation.

appendix 1

Lateral and Seaward Boundaries

The lateral boundaries and the seaward boundary of the Louisiana Coastal Zone will in most likelihood be coextensive with the boundaries of Louisiana's political jurisdiction in the coastal areas. These boundaries (lateral and seaward) present a problem of demarcation, but the rules to define them are fairly clear. The Coastal Zone boundaries east, west, and seaward could be defined in a coastal management program as extending to the limit of Louisiana's jurisdiction east, west, and seaward.

BOUNDARIES AT STATEHOOD

The original boundaries of the State of Louisiana are defined in two acts of Congress which enabled the formation of the State of Louisiana.[1] The Act of 1811, which enabled the people of the territory of Orleans to form a state government,[2] and the Act of 1812, which admitted the State of Louisiana into the Union,[3] used identical language to describe the original boundaries of the State of Louisiana:

> ...beginning at the mouth of the river Sabine; thence, by a line to be drawn along the middle of said river, including all islands to the thirty-second degree of latitude; thence, due north, to the northernmost part of the thirty-third degree of north latitude; thence, along the said parallel of latitude, to the river Mississippi; thence down the said river, to the river Iberville and from thence, along the middle of the said river, and lakes Maurepas and Pontchartrain, to the gulf of Mexico; thence, bounded by the said gulf, to the place of beginning, including all islands within three leagues of the coast.

In 1812, Congress passed an act which enlarged the boundaries of the State.[4] This act allowed the incorporation of the Florida parishes into the State of Louisiana, thus establishing the boundaries of Louisiana as they presently stand. The additional territory was described as follows:

> Beginning at the junction of the Iberville with the river Mississippi; along the middle of the Iberville, the river Amite, and of the lakes Maurepas and Pontchartrain to the eastern mouth of the Pearl river; thence up to the eastern branch of Pearl river to the thirty-first degree of north latitude; thence along the said degree of latitude to the river Mississippi; thence down the said river to the place of beginning.

LOUISIANA-MISSISSIPPI BOUNDARY - LITIGATION

The lateral boundary[5] between Louisiana and Mississippi was the subject of a suit in 1905 between the states.[6] The suit involved the boundary between Louisiana and Mississippi in Lake Borgne and Mississippi Sound. The dispute also involved the status of disputed lands claimed by Mississippi as islands within 6 leagues of the Mississippi coast, and claimed by Louisiana as part of Louisiana's mainland (or at least islands within 3 leagues of the Louisiana coast). Mississippi claimed that all islands within 6 leagues of the Mississippi coastline were granted to Mississippi by Congress upon admission to the Union.[7] The Court held that the Thalweg Doctrine was applicable in this case even though the body of water in dispute was an arm of the sea.[8] The Court ruled that the land in dispute was part of Louisiana because the act admitting Louisiana to the Union was passed before the act admitting Mississippi.[9] The Court established the boundary line between Louisiana and Mississippi in Lake Borgne and Mississippi Sound as follows:

> The deep water channel sailing line emerging from the most eastern mouth of Pearl river into Lake Borgne and extending through the northeast corner of Lake Borgne, north of Half Moon or Grand Island, thence east and south through Mississippi Sound, through South Pass between Cat Island and Isle a Pitre, to the Gulf of Mexico.[10]

Recently Mississippi citizens have asserted that the land between the east and west Pearl rivers be claimed by Mississippi.[11]

LOUISIANA-TEXAS BOUNDARY - LITIGATION

The lateral boundary between Louisiana and Texas has also recently been the subject of litigation between the states.[12] In sea and the line marking the seaward limit of inland waters."[43] The issue of where this defined line was along the Louisiana coast and how it was to be determined was brought before the Supreme Court in 1968.[44] The Court held that the line marking the seaward limit of inland waters was to be determined by the rules of international law embodied in the Convention on the Territorial Sea and the Contiguous Zone.[45] The Court recognized that this decision would cause the coastline to be ambulatory[46] but reasoned that any inconvenience caused by an ambulatory coast could be resolved by legislation or agreement between the parties.[47] The Court felt that it was able to decide many issues involving the application of the Convention to the Louisiana coast, but it referred to a Special Master in several particularized disputes.[48] One of the issues that the Court decided involved a determination of the status under the Convention of several areas along the Louisiana coast in regard to the definition of Bay found in Article 7 of the Convention (the semicircle test).[49] The Court found that outer Vermillion Bay[50] and East Bay[51] did not meet the semicircle test of Article 7 of the Convention. The Court, however, found that Ascension Bay did meet the test.[52] Another issue addressed by the Court was whether islands along the coast were so integrally a part of the mainland that they could be considered part of the coast and, consequently, headlands of bays. The Court held it was permissible under the Convention for an island to be part of the coast and, therefore, headlands of a bay, but they left the factual determination of whether any islands of Louisiana actually formed headlands to the Special Master.[53] The Court did find, however, that the Lake Pelto-Terrebonne Bay complex did present a situation where islands formed the headlands, and therefore, the Bay had multiple mouths.[54]

Louisiana made the argument that some of the areas of the coast, though not meeting the geographic requirements of Article 7(2) to be bays, could still be claimed as "Historic Bay" under Article 7(6) of the Convention.[55] The Supreme Court left the factual determination of Louisiana's claims to Historic Bays to the Special Master.[56] Also, in footnote (97),[57] the Court allowed Louisiana to argue before the Special Master that the United States had actually drawn its international boundaries by the "straight baseline" method found in Act 4 of the Convention.

The Special Master issued his report July 3, 1974. He rejected Louisiana's claim to any historic bays.[58] He also rejected Louisiana's claim that the federal government had drawn a straight baseline to mark the international boundary.[59] If either of these two issues had been settled in Louisiana's favor, the state would have had claim to much more territory. The Special Master also had to decide the factual questions regarding the application of Article 7 of the Convention to various parts of the Louisiana coast. Some of the areas which the Special Master was called to decide on are East Bay, Buchet Bend Bay, Blind Bay, Garden Island and Red Fish Bays, South Pass, Ascension-Caminada-Barataria Bay Complex, Timbalier Bay, Caillou Bay, and Atchafalaya Bay.[60] The Special Master felt, based on his determinations of the actual issues, the holdings of the Court and the stipulations of the parties,[61] that the parties should be ordered to draw a baseline from which the extent of territorial sea subject to Louisiana jurisdiction could be determined.[62]

The Supreme Court heard exceptions to the Special Master in February 1975.[63] The Court adopted all recommendations of the Special Master and rejected all exceptions filed by the United States and Louisiana. The Court then ordered the parties to draw a baseline and to refer the dispute to the Special Master.[64] When this line is drawn the Louisiana seaward boundary will be at least temporarily established subject, of course, to changes in the shape of the coast which would cause the baseline to ambulate.[65]

FOOTNOTES

1. 2 Stat. 641, 701, 708.

2. Id. 641

3. Id. 701.

4. Id. 708.

5. Id. 708. Note: with the addition of the Florida parishes, the River Iberville no longer formed one of the boundaries of Louisiana.

6. Louisiana v. Mississippi, 202 U.S. 1 (1905).

7. 3 Stat. 348 (1817).

8. Louisiana v. Mississippi, supra at 50. The Thalweg is the main channel. The Thalweg was used as the boundary in

For the purposes of these articles, a bay is a well-marked indention whose penetration is in such proportion to the width of its mouth as to contain landlocked waters and constitute more than a mere curvature of the coast. An indention shall not, however, be regarded as a bay unless its area is as large as, or larger than, that of the semicircle whose diameter is a line drawn across the mouth of that indention.

50. Id. 52.

51. Id. 54.

52. Id. 53.

53. Id. 66.

54. Id. 63.

55. Id. 74. Historic Bays are not defined in the Convention. Article 7(6) provides:

> The foregoing provision shall not apply to so called "historic" bays, or in any case where the straight baseline system provided for in Article 4 is applied.

56. Id. 77.

57. Id. 73 note 97.

58. Id. 74.

59. United States v. Louisiana, Report of Walter P. Armstrong, Jr. Special Master, July 31, 1974, p. 13.

60. Id. 5.

61. Id. 22-53.

62. Id. 53.

63. Id. 53.

64. United States v. Louisiana, 95 Sup. Ct. 1180 (1975).

65. Note 61, Report of Special Master supra at 53-54.

appendix 2

Navigable Waters

Both the Army Corps of Engineers[1] (COE) and the Environmental Protection Agency[2] (EPA) have been given authority by Congress to regulate certain activities affecting water bodies. The regulatory activities of these agencies have a profound effect on coastal areas.

The Rivers and Harbors Act of 1899 (RHA)[3] gives the Secretary of the Army, through the Chief of Engineers, authority to issue permits for any work or activity which affects "navigable water[s] of the United States." The COE is also given authority to issue permits, subject to EPA approval, for disposal of dredged or fill material into "waters of the United States" by the Federal Water Pollution Control Act as amended in 1972 (FWPCA).[4] The use by Congress of the terms "waters of the United States" in the FWPCA and "navigable water[s] of the United States" in RHA has led to a dispute between the COE and EPA concerning the extent of jurisdiction granted to the agencies under FWPCA.[5] There will be further comment on this later in this appendix. First, the concept of "navigable water[s] of the United States" will be discussed, and then the importance of the deletion of the word "navigable" by Congress in FWPCA will be considered.

This appendix primarily concerns federal agency jurisdiction. However, the concept of navigability is important in many other areas of the law. Navigability is utilized to determine the scope of the admiralty jurisdiction of federal courts.[6] The federal government is said to be vested with what is often called the "Federal Navigation Servitude," i.e., the paramount power to control and regulate navigation.[7] State governments in most states have title to the bottoms of navigable bodies of water and hold these water bottoms in trust for the benefit of the public and subject to certain public uses such as navigation, fishing, and recreation.

the RHA.[27] Several 1975 cases show the extent to which some courts are willing to extend COE jurisdiction under RHA. In United States v. Sexton Cove Estates,[28] the federal district court for the southern district of Florida found that tidal canals were navigable waters of the United States merely by virtue of their being tidal.[29] The same court, in Weizman v. Corps of Engineers,[30] found that man-made canals that connected with tidal water were navigable waters of the United States even though the canals were connected with the tidal waters only by an aquifer.[31] But compare those two cases with the recent Louisiana decision of Johnson v. State Farm Fire and Casualty.[32] The Louisiana Court of Appeals for the Third Circuit held that canals approximately 20 feet wide and between 5 and 10 feet deep were deep enough to float a piroque or flat bottom boat but were not navigable.[33] There was also evidence that the canal was subject to the tides and was connected to a navigable stream.[34] The court seemed to feel navigability in fact was the sole test for navigability in law[35] and ruled that the canals were not proved navigable. The court in Johnson, however, was concerned about navigability as a factor in the test for admiralty jurisdiction and not as a factor in COE jurisdiction.[36] The use of navigable waters to define both admiralty and commerce clause jurisdiction can lead to inconsistent results. At least one federal court has found that a river navigable under the commerce clause was not navigable in the admiralty sense or at least was not subject to admiralty jurisdiction.[37]

As stated before, the COE under the RHA has authority to regulate activities affecting "navigable water[s] of the United States."[38] This authority has been found to be very broad; it covers such activities as filling in marshland,[39] dumping debris into marshland,[40] and the construction of a roadway system seaward of the mean high tide line.[41] Also, it has been held that any man-made canal which connects with tidal waters becomes navigable not withstanding the fact that the canal is entirely on private property.[42] The jurisdiction of the COE under the RHA has been expanded until as one court stated "...only the most insignificant body of water could escape one of the tests of navigability."[43]

FEDERAL WATER POLLUTION CONTROL ACT

As broad as the definition of navigable waters of the United States is under the RHA, some people do not believe federal regulatory authority under the FWPCA is limited by the requirement that a body of water be navigable. The FWPCA defines navigable waters to mean "waters of the United States."[44] EPA believes that by the use of the term "waters of the United States" Congress intended to eliminate the requirement of navigability from the criteria for jurisdiction under FWPCA.[45] The EPA has defined the term "waters of the United States" to include:

1) All navigable waters of the United States;
2) Tributaries of navigable waters of the United States;
3) Interstate waters;
4) Intrastate lakes, rivers, and streams which are utilized by interstate travelers for recreational or other purposes;
5) Intrastate lakes, rivers, and streams from which fish or shellfish are taken and sold in interstate commerce; and
6) Intrastate lakes, rivers, and streams which are utilized for industrial purposes by industries in interstate commerce.

Under Section 404 of FWPCA, the COE has authority to issue permits for the disposal of dredged or fill materials into "waters of the United States"[46] at selected disposal sites subject to EPA's right to prohibit or restrict the use of any defined area. The COE had originally made no distinction between "navigable water[s] of the United States" and "waters of the United States."[47] The COE administratively defined its jurisdiction to be "navigable water[s] of the United States" and required permits for the disposal of dredged or fill materials into such waters pursuant to FWPCA Section 404.[48] This position was the subject of the recent decision in Natural Resources Defense Council v. Calloway.[49] The federal district court for the District of Columbia found that the COE by limiting its jurisdiction under the FWPCA Section 404 to "navigable water[s] of the United States" as defined by the COE in the Code of Federal Regulations had failed to implement its full Congressional mandate under the Act. The court also ordered the COE to publish proposed new regulations which recognized the full regulatory mandate of FWPCA.

On July 25, 1975 the COE published

14. Hoyer, Corps of Engineers Dredge and Fill Jurisdiction:Buttressing a Citadel Under Siege, 26 U. Fla. L.R. 19, 21 (1973); see also - Economy Light and Power Co. v. United States, 256 U.S. 113, 41 Sup. Ct. 409 (1921).

15. Waring v. Clarke, 46 U.S. (5 How.) 441 (1847), The Orleans, 36 U.S. (11 Pet.) 175 (1837).

16. The Thomas Jefferson, 23 U.S. (10 Wheat.) 428 (1825).

17. 5 Stat. 726 (1845).

18. Genesee Chief v. Fitzhugh, 53 U.S. (12 How.) 443 (1851).

19. The Daniel Ball, 77 U.S. (10 Wall.) 557 (1871).

20. The Montello, 87 U.S. (20 Wall.) 430 (1874).

21. Economy Light and Power Co. v. United States, 256 U.S. 113 (1921).

22. Id. 115.

23. Id. 120-122.

24. Id. 123.

25. United States v. Appalachian Electric Power Co., 311 U.S. 377 (1940).

26. Id. 408.

27. 40 Fed. Reg. 19770. The general definition of navigable water by the COE at 40 Fed. Reg. 19770 is "(1) Navigable waters of the United States. The term, 'navigable waters of the United States,' as used herein for purposes of the River and Harbor Act 1899, is administratively defined to mean waters which have been used in the past, are now used, or are susceptible to use as a means to transport interstate commerce shoreward to their ordinary high water mark and up to the head of navigation as determined by the Chief of Engineers, and also waters which are subject to the ebb and flow of the tide shoreward to their mean high water mark (mean higher water mark on the Pacific Coast)." See 33 CFR 209.260 (ER11165-2-302) for a more definitive explanation of this term.

28. State v. Sexton Cove Estates, 7 ERC 1502 (1975).

29. Id. 1505.

30. Weizman v. Corps of Engineers, 7 ERC 1523 (1975).

31. Id. 1525.

32. Johnson v. State Farm Fire and Casualty Co., La. App., 303 So. 2d 779 (1974).

33. Id. 785.

34. Id. 785.

35. Id. 785. The Court stated that "there is no evidence that this artificial canal was used as a highway of commerce."

36. Id. 781.

37. Adams v. Montana Power Company, 354 F. Supp. 1111 (1973). In this case the water body in question was the Missouri River. Both Congress (33 U.S.C. 2; 20-5; 2.48-1) and the court (185 F. 2d 491) had already declared the Missouri River navigable.

38. 33 U.S.C. 1344, 1411.

39. United States v. Baker, 2 ERC 1849 (1971).

40. United States v. Diamond, 4 ELR 20510 (1974).

41. United States v. Keevon, 7 ERC 1527 (1975).

42. Tatum v. Blackstock, 319 F. 2d 397, 398 (1963).

43. United States v. Holland, 6 ERC 1388 (1974).

44. 33 U.S.C. 1362 (7).

45. 40 C.F.R. 125.1 (0).

46. 33 U.S.C. 1344.

47. 40 Fed. Reg. 19766, also 33 C.F.R. 209, 120.

48. 33 C.F.R. 209, 120.

49. Civil Action No. 74-1242 (Dist. Ct. D.C. March 27, 1975).

50. 40 Fed. Reg. 31324 (July 25, 1975).

appendix 4

Flood Plain Zoning

In 1968 Congress enacted the National Flood Insurance Act[1] to help provide flood insurance for persons in flood-prone areas at subsidized rates. The Act was amended by the Flood Disaster Protection Act of 1973,[2] which gave it more impact and effectiveness. This paper will discuss both of these acts. In addition, it will discuss how the 100-year flood elevation is established, the purpose for which it is established, and the possibility of using the line established south of a designated area as a boundary for the Coastal Zone. Table 1 (which appears at the end of this appendix) shows the status of flood plain zoning in Louisiana coastal parishes as of January 31, 1975.

NATIONAL FLOOD INSURANCE ACT OF 1968

The primary purpose of the National Flood Insurance Act of 1968 is to "authorize a flood insurance program by means of which flood insurance, over a period of time, can be made available on a nationwide basis through the cooperative efforts of the Federal Government and the private insurance industry."[3] Other purposes of the Act are to encourage state and local governments to restrict the uses of land and to discourage development in certain areas in order to minimize flood damage. It also provides standards for construction in future projects, "encourages lending and credit institutions to assist in furthering the objectives of the flood insurance program," and authorizes studies and re-evaluations of the program so that the goals of the Act may be carried out most effectively.[4]

FLOOD DISASTER PROTECTION ACT OF 1973

This Flood Disaster Protection Act of 1973 amends the Flood Insurance Act of 1968 by making the acquisition of flood insurance a prerequisite to the receipt of federal benefits. The 1973 Act provides:

> ...[N]o Federal officer or agency shall approve any financial assistance for acquisition or construction purposes for use in any area that has been identified by the Secretary as an area having special flood hazards and in which the sale of flood insurance has been made available under this chapter, unless the building or mobile home and any personal property to which such financial assistance relates is, during the anticipated economic or useful life of the project, covered by flood insurance....
>
> Each Federal instrumentality responsible for the supervision, approval, regulation, or insuring of banks, savings and loan associations, or similar institutions shall by regulation direct such institutions not to make, increase, or renew...any loan secured by improved real estate or a mobile home located or to be located in an area that has been identified by the Secretary as an area having special flood hazards and in which flood insurance has been made available under this chapter unless the building or mobile home and any personal property securing such loan is covered for the term of the loan by flood insurance....[5]

Generally, the program offers flood insurance at subsidized premium rates for existing structures in flood-prone areas if two conditions are met: 1) communities implement land use and control measures to reduce or avoid future losses; and 2) non-subsidized actuarial rates are charged for future construction in flood plains.

Communities entering the National Flood Insurance Program generally do so in two phases. First, they become eligible for the sale of flood insurance under an "Emergency Program." The Emergency Program allows a community to submit a resolution to the Flood Insurance Administrator indicating its desire to be included in the federal insurance program. While a Flood Hazard Boundary Map (FHBM) and a Flood Insurance Rate Map (FIRM) are being developed for the community, the community will be provided with a "first layer" insurance coverage (one-half the maximum insurance available under the "Regular Program") at federally subsidized rates on all existing and new construction begun prior to the effective date of the Flood Insurance Rate Map. After a flood insurance rate study has been completed, the community enters

LOUISIANA LAW ON FLOOD PLAIN ZONING

Louisiana's statute authorizing zoning by municipalities provides that such zoning shall be made with reasonable consideration, among other things, to the character of the district and its peculiar suitability for particular uses and with a view to conserving the value of buildings and encouraging the most appropriate use of land throughout the municipality. This law allows the municipalities to create a comprehensive plan for construction of streets, sewerage systems, fire prevention, population density, water supply, and other related problems.[14] However, this law only provided municipalities with the power to zone. Since parishes were not included in this statute,[15] the Legislature passed Act 116 of 1971[16] and Act 141 of 1973.[17]

Act 116 authorizes parishes and municipalities to enact ordinances, rules, and regulations, including zoning and land use regulations, which are necessary to comply with the requirements of the 1968 National Flood Insurance Act.

The Louisiana Revised Statute 33:1236 regulating powers of police juries was amended in 1973 to include Act 141. Act 141 gives police juries and other parish governing authorities power to enact further ordinances necessary to comply with the new requirements of the Flood Insurance Act as amended. All parishes, except Caddo, shall have the power to pass zoning ordinances, subdivision regulations, building codes, health regulations, and other applications and extensions of the normal police power necessary to provide standards and effective enforcement provisions for the prudent use and occupancy of flood-prone and mudslide areas.[18]

STATUS OF LOUISIANA FLOOD INSURANCE

A survey of 26 parishes in the coastal region of the state of Louisiana was made. One of these parishes, Livingston, has not been designated a flood plain by HUD. Of the rest of the parishes, as of May 1, 1975, 21 have adopted some type of ordinance or resolution regulating land use in flood-prone areas. The other four parishes have submitted a letter to the Administrator of the Flood Insurance Program and are thus carried on the Emergency Program (see Table 1 at end of this appendix). In spite of the fact that the other parishes have adopted ordinances, most of them will continue to be carried on the Emergency Program until all studies of these parishes are completed. As mentioned previously, the Emergency Program allows a community to buy flood insurance at subsidized rates until the Flood Hazard Boundary Maps and the Flood Insurance Rate Maps have been completed. A period of 15 years ending July 31, 1983, was allotted for the purpose of such studies.[19] Lafourche Parish has been on the Regular Program but has recently been put back on the Emergency Program. The problems with Lafourche and Terrebonne Parishes developed after the completion of the first study when developers put up ring levees. There is a question as to whether the elevation requirements of the National Flood Insurance Act are required inside the levees.

All of these parishes have used the 100-year flood elevation as a standard for building requirements. Orleans Parish was one of the first communities in the United States to begin a flood protection program. At the outset they used the 40-year flood elevation to try to ease the people into the program gradually. Now they have adopted the 100-year flood elevation and eventually hope to have everything to meet the 200-year flood elevation standards.

A survey was also made of several municipalities. Some of these municipalities have also adopted land use regulations.

The land use regulations generally follow a similar form which includes a statement of the purpose of the regulations, definitions, articles requiring building and occupancy permits, use of coastal high hazard areas, utilization of neighboring flood management programs, waiver of regulations, penalties for violation of land use and control measures for flood-prone areas, and an article explaining what happens if flood-prone area regulations conflict with other ordinances.

PROCEDURES FOR SETTING UP PROGRAM

The Federal Insurance Administration is given funds to conduct studies. They make contracts with the Corps of Engineers and also with private engineering firms. The studies include investigations of all streams in a parish that could cause flooding and determination of the flows of rivers. Gauges are used to determine the amount of water flowing past a certain mark during a designated period. Rainfall charts for past years are studied if these are available. Information is obtained from all sources on past conditions, and evaluations are made on the areas subject to flooding. The engineers establish the 100-year flood level and evaluate the conditions the Coastal Zone boundary as the 100-year flood elevation line which traverses the state from east to west and south of Highway I-10 and I-12 east of Baton Rouge (or Highway 190). There will, of course, be certain areas in this region which have a higher mean sea level elevation than that established by the 100-year flood elevation line. Leaders in these areas might object to Coastal Zone regulations. However, even though elevations are higher, many actions in these areas could affect coastal waters and thus legitimately should be included in coastal management programs.

The above mentioned boundary (100-year flood elevation line south of I-10) would be preferable to the inclusion in the Coastal Zone of all the flood-prone areas within a selected list of parishes. Some parishes object that their parish should not be regulated in its entirety since portions of it have no relation to the coastal area. This might lead to political pressure to keep entire parishes out of the Coastal Zone Management Program when the participation of part of the parish is essential to the success of the program. If the 100-year flood elevation line south of I-10 were used, most of the areas vital to coastal management interests would be included.

FOOTNOTES

1. National Flood Insurance Act of 1968, 42 U.S.C. 4001-4127 (1968).

2. Flood Disaster Protection Act of 1973, 87 Stat. 980, 42 U.S.C. 4001-4128 (Supp. 1975); 24 C.F.R. 1909 et seg.

3. 42 U.S.C. 4001(d).

4. Id. 4001(e).

5. 42 U.S.C. 4012(a) & (b), 4106(a) & (b) (Supp. 1975).

6. Notice of Proposed Rule Making, National Flood Insurance Program, 24 C.F.R. 1909, 1910, 1911, 1914, 1915, 1917, 40 Fed. Reg. 13420 (March 26, 1975).

7. Proposed Rules 24 C.F.R. 1910.22, 40 Fed. Reg. 13426 (March 26, 1975).

8. Id. 1910.3

9. Id. 1909.1

10. Id. 1910.3

11. Id. 1910.3(e)

12. 42 U.S.C. 4013

13. Proposed Rules 24 C.F.R. 1911.5(g), 40 Fed. Reg. 13432 (March 26, 1975).

14. La. R.S. 33:4723

15. The new state Constitution gives both municipalities and parishes the right to enact zoning laws, but the Legislature has not taken action to implement the law.

16. La. R.S. 38:84 (Act 116 2 of 1971).

17. La. R.S. 38:1236 Par. 38 (Act 141 of 1973).

18. La. R.S. 33:1236

19. Proposed Rules 24 C.F.R. 1914.1(a), 40 Fed. Reg. 13432 (March 26, 1975).

20. Id. 1909.1(1)

21. Information obtained from William Addison of the City-Parish Department of Public Works in Baton Rouge and Roy Farmer of the U.S. Army Corps of Engineers in New Orleans. Proposed Rules 24 C.F.R. 1911.5(g).

BIOPHYSICAL CRITERIA APPENDICES

		written and compiled by
Appendix 5.	Geology - Pleistocene/Recent Contact	Patricia A. Byrne Rodney D. Adams
Appendix 6.	Elevation - 5 and 25-Foot Contours	Patricia A. Byrne B. Lincoln Smith, Jr.
Appendix 7.	Soils - Wetland/Non-Wetland Boundary	Patricia A. Byrne Robert A. Segall
Appendix 8.	Vegetation - Wetland/Non-Wetland Boundary	Patricia A. Byrne John W. Day James J. Hebrard
Appendix 9.	Hundred Year Flood and Tidal Inundation Level	Patricia A. Byrne B. Lincoln Smith, Jr.
Appendix 10.	Salinity - Inland Intrusion	Gloria K. Drew Patricia A. Byrne B. Lincoln Smith, Jr.
Appendix 11.	Occurrence of Rangia cuneata (Brackish Water Clam)	James J. Hebrard William G. McIntire
Appendix 12.	Inland Records of Callinectes sapidus (Blue Crab)	James J. Hebrard Gloria K. Drew Patricia A. Byrne
Appendix 13.	Inland Records of Marine Fish	J. V. Conner James J. Hebrard Patricia A. Byrne Gloria K. Drew
Appendix 14.	Reptile and Mammal Ranges	James J. Hebrard
Appendix 15.	Coastal Hiatus of Spring Trans-Gulf Bird Migration	S. A. Gauthreaux, Jr.

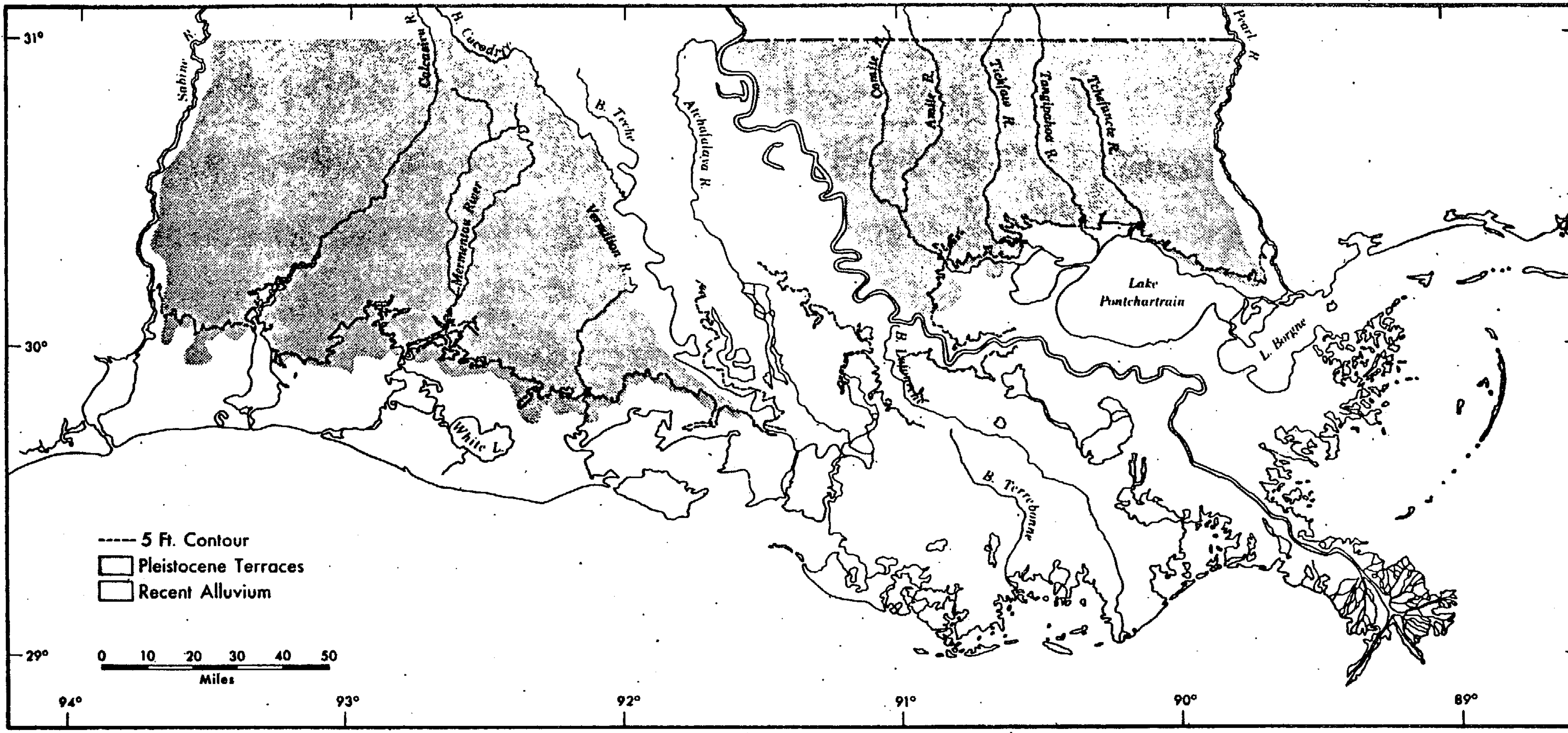


Figure 2. Distribution of Pleistocene Terrace (uplands) and Recent Alluvium (wetlands) in coastal Louisiana. This is the line of contact where landward rising Pleistocene deposits outcrop above the onlapping, relatively flat, near sea level marshlands. This outcrop generally separates wetland from non-wetland environments. This map was produced from that of Saucier (1974), which is the most recent at a scale larger than that commonly available.

RECENT DELTAIC PLAIN

The deltaic plain has traditionally been separated from the alluvial valley by a line extending between the towns of Franklin and Donaldsonville (Fisk, 1944). Five major delta complexes where the master stream has flowed in the past or is presently located dominate coastal Louisiana from the western margins of Vermilion Bay eastward to and including the Chandeleur Islands. These delta lobes include the following from oldest to youngest:

Maringouin-Mississippi

Teche-Mississippi

St. Bernard-Mississippi

Lafourche-Mississippi

Plaquemines-Modern Mississippi

These deposits are in varying degrees of deterioration due to compaction and subsidence and are characterized by partially or completely buried levee ridges flanked by marsh and swamp deposits which grade to lakes or bays. They are bordered on their seaward end by barrier islands, sand and shell beaches, or marshlands exposed to direct wave attack.

The high ground in the deltaic plain consists of natural levees of active and relict river courses, beaches and cheniers, and salt domes. In recent years dredging and spoil bank deposits have increased on the landscape. This activity has formed extensive artificial high ground ridges throughout the marsh. In most cases the high ground forms an island or is a linear feature which is either surrounded or flanked by wetland environments.

RECENT CHENIER PLAIN

The Recent Chenier Plain of southwestern Louisiana lies out of the direct influence of the delta proper. Its development is related to westward and eastward shifts of the Mississippi River; changes in the Sabine, Calcasieu, Mermentau, and Vermilion Rivers; their associated sediment supply; and dominant westward flowing littoral currents. Westward shifts of the Mississippi River supplied sediments which resulted in coastal accretion. Eastward shifts of the Mississippi River resulted in coastal regression and beach ridge or chenier development. Seaward extension of the shoreline was primarily by beach accretion, followed by marshlands developing in swales between beaches. Local rivers (Sabine, Calcasieu, etc.) have also contributed to seaward land growth through accretion ridges forming at their mouths.

The plain dominates coastal Louisiana from Vermilion Bay westward to the Texas border. Recent deposits which are about 9 meters (30 ft) in thickness at the coast cover the underlying Pleistocene material and thin to zero at the inland surface line of Pleistocene/Recent contact. The high ground (non-wetland) in this area includes remnant low Pleistocene islands which form outliers in the marsh, chenier ridges, and beaches. Extensive canal dredging and diking has occurred in this area; the Intracoastal Canal was dredged in the more resistant Pleistocene deposits but is in close proximity to the line of Recent marsh contact.

LIMITATIONS AND EXTENUATING CIRCUMSTANCES

There are many papers discussing the Pleistocene/Recent boundary but large scale official maps are nonexistent. Any attempt to project these delineations up to a scale of 1:250,000 would only enhance the inaccuracies of an already generalized map.

The map published in Saucier (1974) is the most recent at a scale (1:1,267,200) larger than that commonly available. It was chosen as the base from which an optical projection to a scale of 1:250,000 was made. A model 55C Map-O-Graph map and chart Projector-Enlarger was used for this scale transfer. While there is no compensation for transfer from one map projection to another it was felt that this 4X enlargement was sufficiently accurate to give a representative map of the Pleistocene/Recent oundary.

Another limitation arises; even at a scale of 1:250,000, small outliers or prominences cannot be delineated. Therefore, some terrace material is actually mapped as coastal marsh, particularly in southwest Louisiana, but for the purpose of this study the generalization will suffice.

RELATIONSHIP TO COASTAL ZONE BOUNDARY DELINEATION

The topographic break at the line of Pleistocene/Recent contact forms a natural boundary between wetland and non-wetland environments. Although irregular, the contact produces an unconformity which extends east-west across the entire state. In general, the elevation of the contact lies in close proximity to sea level. The

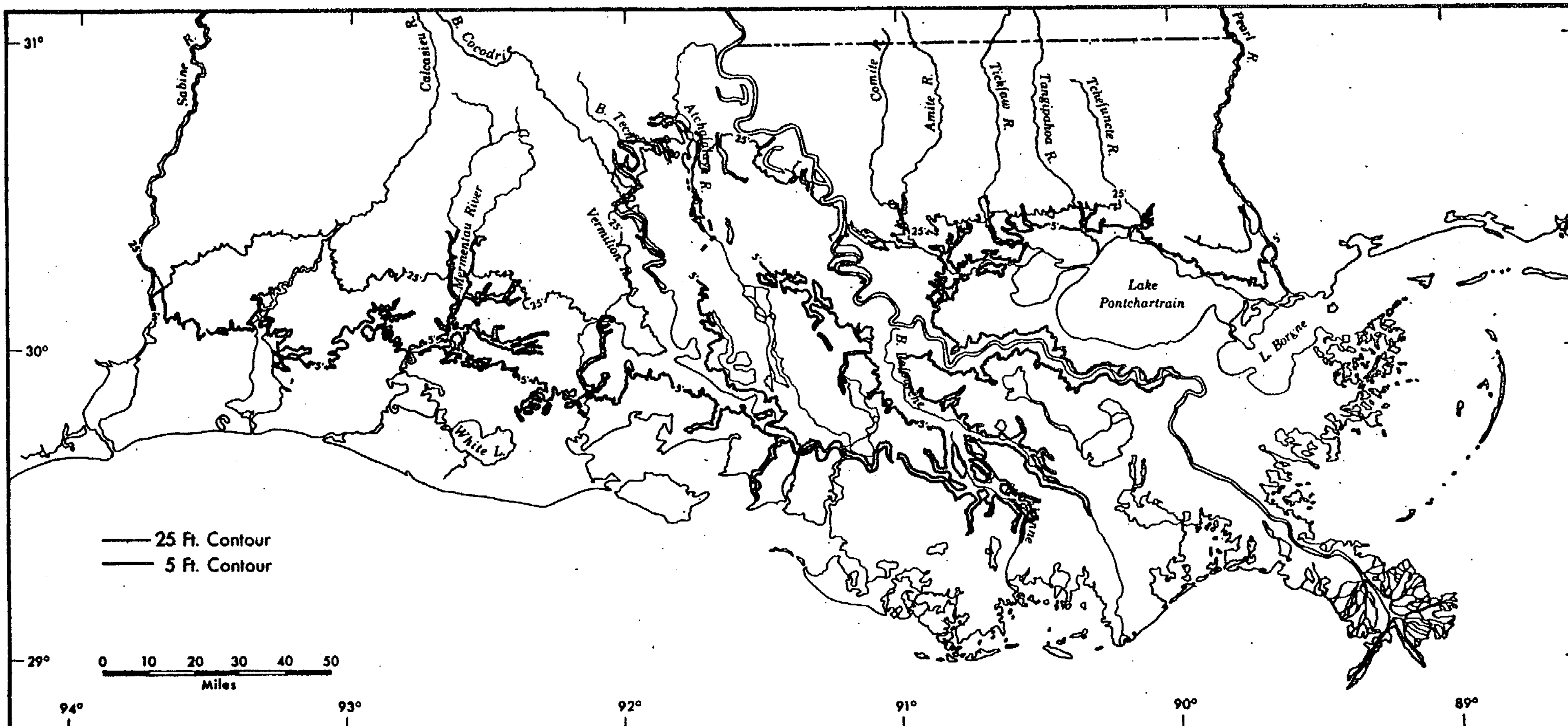


Figure 3. Distribution of 5 and 25-foot (1.5 and 7.5-meter) contours in coastal Louisiana. The 5-foot contour is the lowest elevation delineated on 1:24,00 maps produced by the U.S. Geological Survey. The 25-foot contour is the lowest depicted on 1:250,000 USGS maps. The 5-foot contour was selected as the best-fit reference line which delineates the approximate position of Pleistocene/Recent contact and the boundary between wetland and non-wetland soils and vegetation.

Employment of more accurate measurements (digitizing, etc.) in transferring the 5-foot contour line from the quadrangles to the 1:250,000 maps would have been more desirable. However, the quadrangles and the 1:250,000 scale maps are of different projections (Transverse Mercator Projection 1:250,000; Polyconic Projection 1:24,000) and the degree of accuracy would remain debatable.

The 5-foot contour is relevant to Coastal Zone boundary considerations in several ways. The heights of high tides for 1974 were predicted for various stations in coastal Louisiana (National Ocean Survey, 1973). These predictions were based on historic data which take into account lunar effects and seasonal variation in sea level due to atmospheric conditions. Although the predicted diurnal lunar tidal range was about 1 foot, the maximum predicted height of high tide for the area from Atchafalaya Bay west ranged from 2.7 to 4.2 feet (0.8 to 1.3 meters) above mean sea level for 12 stations. The maximum for the area east of this location ranged from 2.5 to 2.9 feet (0.8 to 0.9 meter) above mean sea level for 22 stations considered. Therefore, to map the extent of tidal influence based on this data up to 1974, the 5-foot contour exceeds the elevation of raised water levels caused by some tropical and lesser velocity storms. Storm surges in advance of hurricanes and high velocity tropical storms exceed this level. The 100-year flood and storm tidal levels reach about 12 feet (3.7 meters) above mean tidal level.

Tidal marshes generally develop to approximately the height of mean high lunar tide level and therefore lie below the 5-foot contour. Natural levees, beach ridges, salt domes, and dredged spoil banks stand above the 5-foot datum, but these features are intricately linked with the ecologic and hydrologic processes in coastal wetlands. All of these features lie below the 25-foot contour except for Mississippi River levees in the upper portions of the flood plain near Baton Rouge and abandoned levees of the Teche-Mississippi above Lafayette.

In consideration of boundary criteria, the 5-foot contour line was selected as the best-fit reference line which delineates the approximate position of Pleistocene/Recent contact and the boundary between wetland and non-wetland soils and vegetation.

REFERENCES

Louisiana Quadrangle Maps. 7.5 Minute Topographic Series. Scale: 1:24,000. Available from U.S. Geological Survey, Denver, Colorado 80225 or Wash., D.C. 20242, from the State of Louisiana, Dept. of Public Works, Baton Rouge, La., or from their local agents.

National Ocean Survey, 1973. Tide tables, high and low water predictions, 1974, East Coast of North and South America. Natl. Ocean Survey, Rockville, Md. 20852.

U.S. Geological Survey Maps. Scale: 1:250,000. Available from the U.S. Geological Survey, Denver, Colorado 80225 or Wash., D.C. 20242, or from local suppliers.

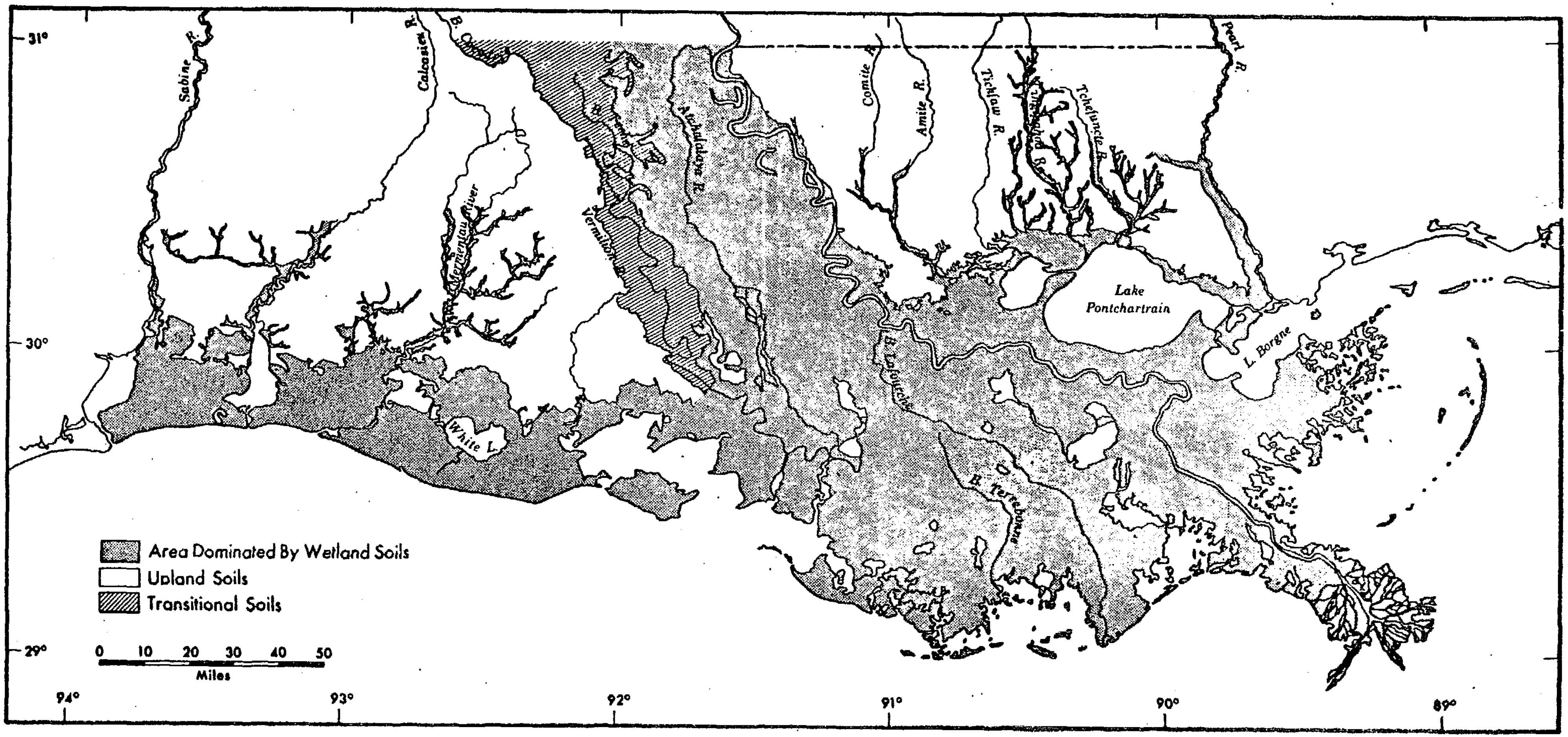


Figure 4. Distribution of wetland and non-wetland soils boundary. Information was obtained from Parish Soil Maps published by the Soil Conservation Service of the Department of Agriculture. Some soil associations containing both wetland and non-wetland materials were categorized as Transitional and were mapped with wetland or non-wetland soils according to the dominant percentage of each type. Those Transitional soils associated with the Teche-Mississippi Meander Belt on the western margin of the Atchafalaya Basin were so complex that they could not be logically mapped as either wetland or non-wetland.

appendix 8

Vegetation — Wetland/Non-Wetland Boundary

Vegetation habitats and distributions are important considerations in addressing the problem of Coastal Zone delineation. The abundance and variety of vegetation contribute significantly to productivity and to the nutrient budget in Louisiana's richly endowed wetland areas. Information was assembled from several sources which delineated wetland from non-wetland vegetation. This information was mapped at a scale of 1:250,000. The boundary from this map was reduced in scale to produce Figure 5.

Characteristic "signatures" on NASA high altitude false-color infrared photography were used to delineate coastal marshes and estuarine and riverine swamps. A broad band of coastal marsh lies seaward of the Pleistocene terraces from the Sabine to the Pearl River. Cypress-tupelo gum swamp dominates the upper margins of the more extensive estuarine basins and grades into bottomland hardwoods where river basins cut into terrace uplands. In southwest Louisiana the marshes extend up to the seaward edge of prairie (grassland) uplands and follow up incised river valleys before grading into swamp forests. In south-central and southeastern Louisiana coastal estuaries are more extensive and develop extensive swamp forests before giving way to terraces dominated by longleaf pine or upland hardwoods.

At this stage no attempt was made to separate marsh and swamp vegetation as boundary criteria extended above the line separating the two zones. This delineation will be made later on a basin by basin basis.

Vegetation distribution reflects the extent of coastal lowlands, and the continuation of swamp forests up river basins shows the interdependence of coastal estuaries and these adjacent river basins. Details of nutrient interdependency emphasize the rationale that a significant portion of these river basins should be included in the Coastal Zone.

Chabreck et al. (1968) developed a vegetation map that classifies the coastal marshes into saline, brackish, intermediate, and fresh types based on systematic transect data. This represents an "instantaneous" view of the marsh vegetation and gives coverage to the entire length of the Louisiana coast. Species compositions of the marsh types are given by Palmisano (1970) and Chabreck (1972). The saline marsh type is characterized by the presence of *Spartina alterniflora*, *Distichlis spicata*, *Juncus romerianus*, and *Spartina patens*. Brackish marsh is characterized by *Spartina patens* and *Distichlis spicata*, while intermediate marsh is dominated by *Spartina patens*, *Phragmites communis*, and *Sagittaria falcata*. Species characteristic of fresh marsh include *Panicum hemitomon*, *Sagittaria falcata*, *Eleocharis* sp., and *Alternanthera philoxeroides*.

Extending inland from the Gulf up river flood plains, marshes grade into cypress-tupelo gum swamps. Darnell (1961) recognized the importance to estuarine-food chains of detritus (decayed plant and animal material) carried into the estuaries from swamps and marshes. Day et al. (1975) reported on studies of productivity and nutrient budget in a cypress-tupelo gum swamp surrounding Lac des Allemands. Export of nutrients was monitored in Bayou des Allemands just above highway U.S. 90 through which practically all water from the upper basin flows into the marshes to the southeast. Yearly export figures for organic carbon, total nitrogen, and total phosphorus were 8016, 1075, and 154 metric tons, respectively. Two interesting observations were noted associated with the passage of Hurricane Carmen in September 1974 (John W. Day, personal communication). Peak litterfall from swamp trees occurred during the hurricane's passage rather than during the normal period in November, and there was a large pulse of organic matter and nutrients flushed into the lower estuary by the rain waters of the hurricane. This suggests that hurricanes (and lesser tropical storms as well) are important mechanisms for connecting the upper basins to lower estuaries.

The des Allemands swamp is a non-riverine swamp; it is not flooded by high river waters due to man-made levees. Studies in South Carolina (Kitchens et al., 1974) show that riverine swamps (such as those of the Pearl, Sabine, and Atchafalaya Rivers) absorb inorganic nutrients from flooding river waters and release them in

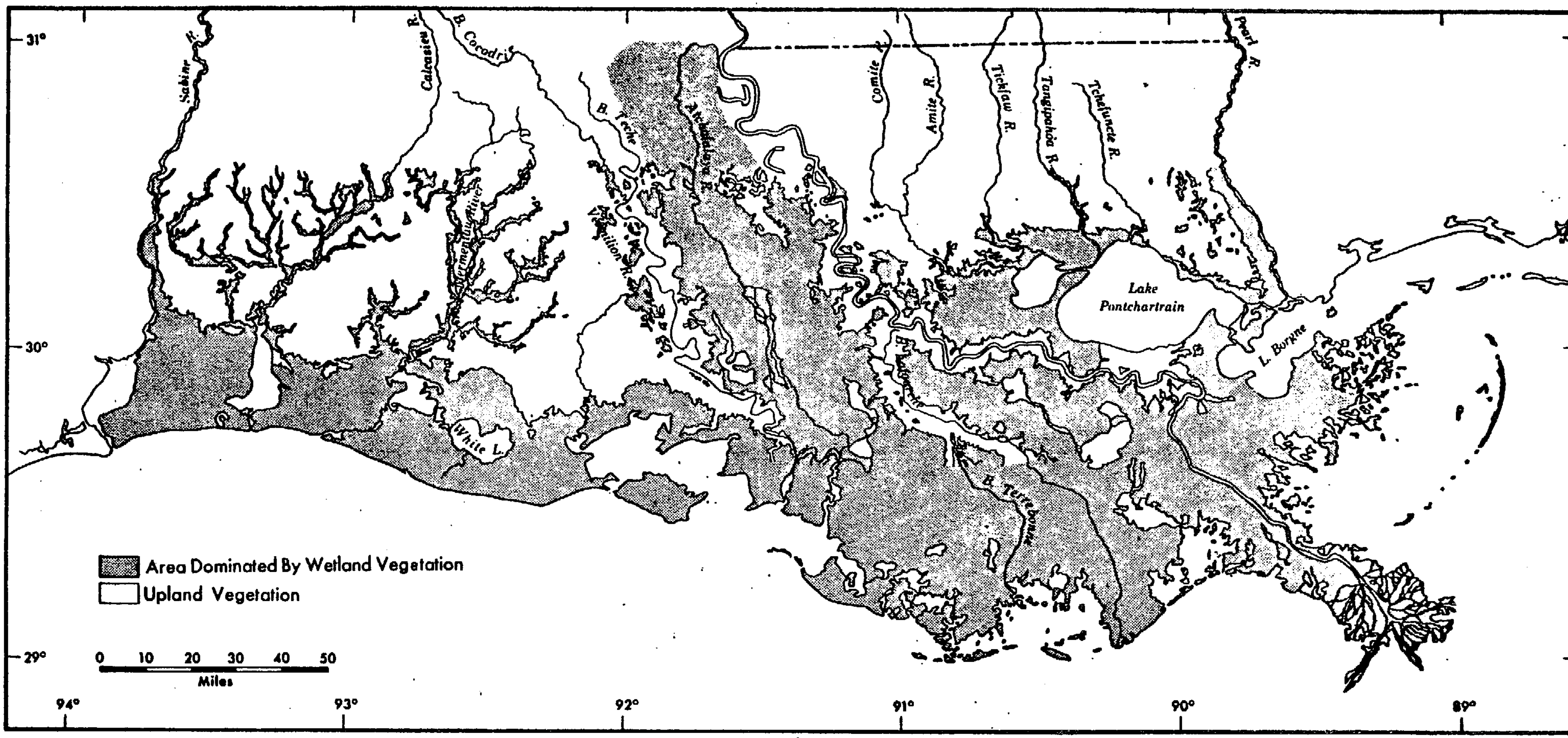


Figure 5. Distribution of wetland and non-wetland vegetation in Louisiana coastal areas. Information was assembled from several previously published vegetation maps of southern Louisiana and from NASA high altitude false-color infrared photography. No attempt was made to separate marsh and swamp vegetation as boundary criteria extended above the line separating the two zones.

appendix 9

Hundred Year Flood and Tidal Inundation Level

Data concerning the 100-year flood and tidal inundation level provide supportive information for inland Coastal Zone boundary delineation. Both river floods and storms causing elevated Gulf waters inundate the low lying coastal marshlands and swamplands. (For a discussion of the legal aspects of flood plain zoning, see Appendix 4.)

Flood hazard maps for southern Louisiana at a scale of 1:250,000 were prepared from 1:62,500 and 1:24,000 scale maps provided by the Geological Survey and the Army Corps of Engineers. They were composited to provide maximum coverage of southern Louisiana. The information is presented in Figure 6. Regions not covered by the large scale maps have been left blank and are conspicuous. In general, the 100-year flood and tidal boundary lies between the 10 and 15-foot (3.0 and 4.5-meter) elevation contours (above mean sea level) in areas inland from the marsh. The boundary, however, follows the river basins up to the 31°00' North latitude line, and calculations of cross sectional area of the basins determine how much land is inundated. Major levee systems remain unflooded.

In addition, flood hazard reports with detailed flood information are available from the Corps of Engineers. These have been designed for economic studies, for formulating zoning regulations, and for setting design criteria to minimize future flood losses. These maps present an interpretative delineation of flood boundaries that have existed during the period of record for flood elevations. Floods that may inundate larger areas are possible, but no attempt has been made to show their probable limits.

The purpose of the flood-prone area maps is to show to adminstrators, planners, and engineers concerned with future land development those areas that are subject to flooding. The U.S. Geological Survey was requested by the 89th Congress to prepare these maps as expressed in House Document number 465. "Although the maps do not establish flood-zone boundaries nor impose limitations on land use, the flood data provide a technical base on which responsible officials can make decisions for developing building and zoning regulations, locating waste-disposal facilities, developing recreational areas, and evaluating the economic development of flood plains" (Lowe, 1975, p. 1).

These maps are completed as funds become available for this specific purpose. They are prepared for 7.5 and 15 minute topographic quadrangles to show the interpretative delineation of the highest flood elevation that has occurred.

Flood-prone area maps were delineated for those areas that meet the following criteria: 1) Urban areas where the upstream drainage area exceeds 15 square miles (39 square kilometers), 2) rural areas in humid regions where the upstream drainage area exceeds 100 square miles (259 square kilometers), and 3) rural areas in semiarid regions where the upstream drainage area exceeds 250 square miles (650 square kilometers).

The flood-prone areas shown on the maps have a 1 percent chance on the average of being inundated during any year. Flood areas have been delineated without consideration of present or future flood-control storage that may reduce flood levels. These maps show flood boundaries that were estimated from profiles based on high-water marks and tide frequency without consideration of probable run-up or attenuation of tidal values. The 100-year flood or tide level was extrapolated from tide height-frequency relationships.

The tide height-frequency data were obtained from Geological Survey stream gage records, Corps of Engineer stream gauge records, personal observations, and high water marks left by floods. Flood peaks were plotted on a vertical axis against stream miles to obtain a stream bed profile to indicate the general direction of valley flood flow. "The extent of flooding was delineated on the topographic maps by using the flood profiles to define the flood elevations at various points along the channel and locating the elevations on the map by interpolating between contours. The accuracy of the flood boundaries is consistent with the scale and contour interval of the quadrangle" (Lowe, 1975, p. 2). There is a chance of error where these changes have not been incorporated on the

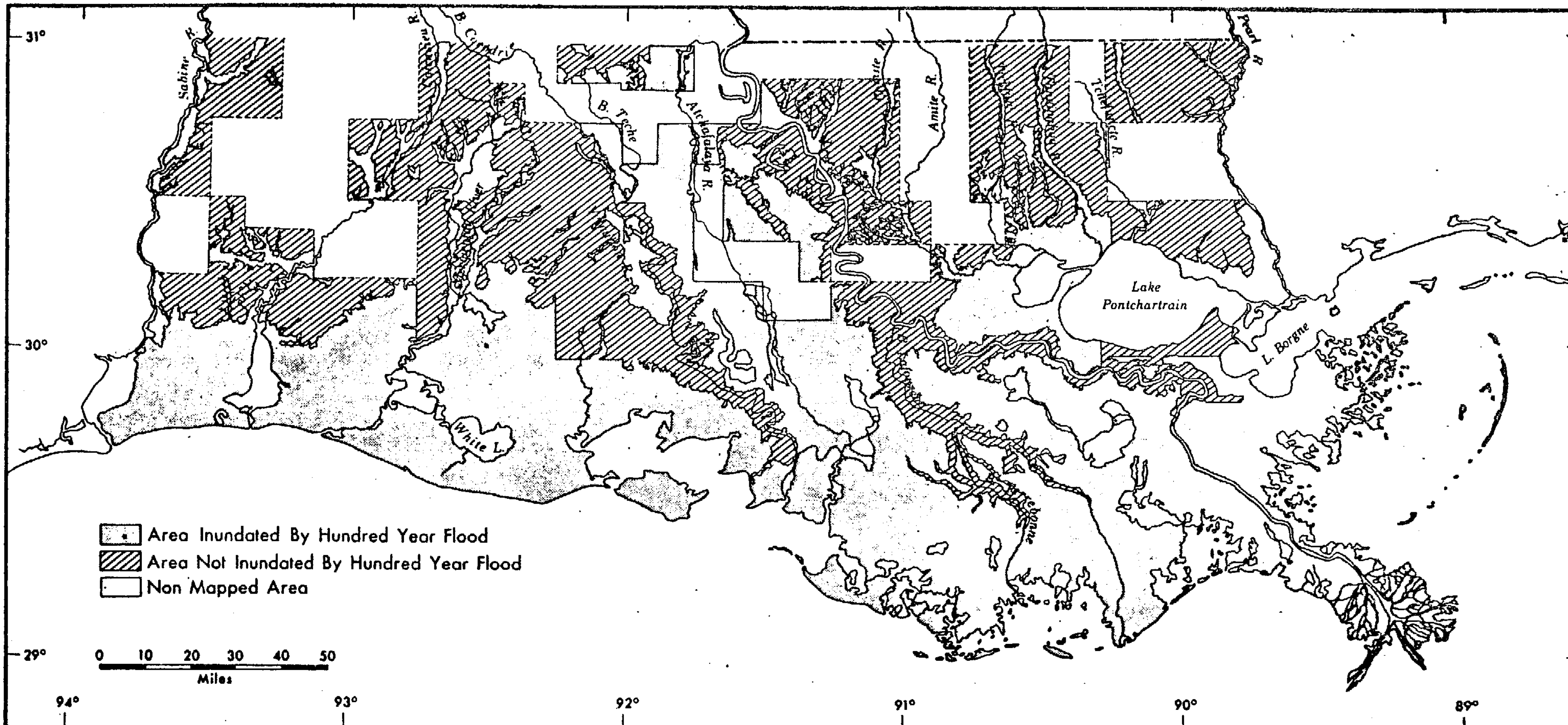


Figure 6. Extent of flooding expected to occur once every hundred years; obtained by summarizing past records of flood water inundation. Information was taken from 1:62,500 and 1:24,000 scale maps provided by the U.S. Geological Survey and the U.S. Army Corps of Engineers. Regions not covered by the large scale maps have been left blank and are conspicuous. In general, the 100-year flood line lies between the 10 and 15-foot elevation contours in areas inland from the marsh.

appendix 10

Salinity — Inland Intrusion

Inland intrusion of salinity is one of the biophysical parameters examined with regard to its relevance to Coastal Zone inland boundary delineation. The Federal Coastal Zone Management Act of 1972 defines Coastal Zone as "the coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder), strongly influenced by each other and in proximity to the shorelines of the several coastal states, ..." The term coastal waters includes "bays, shallows, and marshes, and in other areas, those waters, adjacent to the shorelines, which contain a measurable quantity or percentage of seawater including but not limited to, sounds, bays, lagoons, bayous, ponds, and estuaries." Since the primary characteristic of seawater is its salt content (salinity), this wording in the act makes salinity an important chemical parameter in determining the boundary of the Coastal Zone. In addition, salinity is also the parameter which most strongly influences species distribution. For these reasons, salinity has been exhaustively studied. The objective was to show just how far inland these marine influences extend.

The universal dimension for reporting total dissolved solids in seawater is salinity in parts per thousand (S ppt). This refers to the total weight in grams of solid matter dissolved in 1000 grams (1 kg) of seawater.

The formal definition of salinity is "the weight in grammes of the dissolved inorganic matter in 1 kg of sea water, after all bromide and iodide have been replaced by the equivalent amount of chloride, and all carbonate converted to oxide" (Cox, 1965). Until about 1900 this slow and difficult method was used with good reproducibility. Because of the method's difficulty, however, other methods of determining salinity came under scrutiny--among them, conductance, density, and chloride content. The Stockholm Convention of 1899 found a close correlation between the chloride content of seawater and the salinity. This new parameter called chlorinity (Cl) was defined as the "halide concentration in parts per mille by weight, measured by reaction with silver nitrate, and computed on the assumption that all the halide is chloride" (Cox, 1965).

They then put forth the mathematical expression:

$$\text{S ppt} = 1.805 \ \text{Cl ppt} + 0.030 \qquad (1)$$

This relation has been used almost exclusively for years but with advancing technology and more stringent demands on accuracy this relationship has been challenged and the form

$$\text{S ppt} = 1.80655 \ \text{Cl ppt} \qquad (2)$$

has been suggested (Cox et al., 1967, p. 213). Usually salinity is then rounded to two decimal places.

The constant 0.030 in equation (1) above was an allowance for the diluting effect of fresh water of Baltic rivers. The elimination of this constant does not appreciably affect salinities ranging between 30 and 40 ppt in open ocean salinities. However, below these values and near the land-sea interface in estuarine waters, the variability between samples far exceeds the error due to the elimination of that constant.

It should also be borne in mind that the ion composition of estuarine waters may vary significantly from those of pure oceanic seawater. Sea-land boundary waters "generally have more carbonate and sulphate relative to chloride with an accompanying increase in ratio of calcium to sodium" (Collier, 1970).

During the last 25 years the "salinity" concept has been further complicated by the widespread adoption of electrical conductivity for the determination of salinity. This method has widespread use due to speed and convenience of handling large numbers of samples. The method does not require a skilled analyst or a lot of supporting equipment. There are, however, difficult problems associated with using conductance to determine salinity.

Electrical conductivity in general increases with both temperature and salinity or chlorinity. If it is assumed that a a particular place.

Because of the wide range of possible choices of measurement and other limitations of salinity data discussed above, all of which make correlating different sets of data difficult if not impossible, it seems best to look both at averages and extremes of salinity data, thus getting some idea of the normal conditions that may prevail under extreme circumstances.

Figure 7 includes two methods of demonstrating the distributions of salinity across the state as far east as the Pearl River Basin. (In this area, lack of data to support construction of a meaningful histogram made the type of presentation on the map insert more feasible.) The dashed line represents the 5 ppt salinity line published by the Louisiana Wildlife and Fisheries Commission (Barrett, 1971). The data used to produce this line represent average salinities during the sampling year April 1968 to March 1969, which is considered an average year, and are taken from continuous recordings 1 foot (0.3 meter) below the surface of the water.

Also included in Figure 7 are histograms, which were chosen as a readily demonstrable method of showing not only the high and low extremes (during a given period at a given location) but also the frequency, duration, and inland extent of measurable and meaningful values. According to various authorities, the maximum amount of chloride desirable for human consumption is 0.250 ppt (Cardwell et al., 1967, and other sources). Correlated with the equations given earlier, this converts to a specific conductance of 1.1 millimho/cm at 25°C and a salinity of 0.45 ppt. This latter figure was used as one of the criteria in constructing the histograms to reflect pulses of marine influence up the river basins. In this report, the upper limit for freshwater is considered to be 1.1 millimho/cm. Conductance in the 1.0-1.2 millimho range is referred to as saline water. In analyzing the data to choose significant points for which to produce histograms, considerable caution was observed to look for decreasing measurements of conductivity from the Gulf landward and to eliminate stations at which high conductivity or chlorinity measurements were recorded but for some reason there was suspicion that these readings were due to factors other than intrusion of seawater, such as industrial effluents or agricultural runoff. Some pristine river waters also contain ions, such as calcium and magnesium ions both as carbonates and noncarbonates, which will give measurements of specific conductance which would be falsely representative if converted to salinity.

The relationship of salinity to the boundary question is complex because the quantity, quality, and extent of up-basin intrusion vary temporally and seasonally. Conceptually, dry years in the river basins should show the greatest extent of inland marine influence but tropical storms and hurricanes from the Gulf also drive marine waters far inland. Tropical storms occur annually along the coast, and even during wet periods drive marine waters inland. More frequently occurring lesser but persistent winds from the southerly and easterly quadrants, along with barometric pressure influences, contribute significantly to salt water perturbations up river basins. The histograms reflect some aspects of salinity intrusion, but the paucity and placement of instrument stations limit the resolution of the data.

The figures and limitations discussed above are helpful in interpreting the histograms on the map in Figure 7. Full-sized copies of Histograms A-K and the map insert (Figure 7A) shown in reduced form in Figure 7 are included at the back of this appendix to permit the inclusion of more detailed information about each histogram.

Generally, the histograms indicate that pulses of Gulf water intrusion extend up each river and stream at least several miles. In the Sabine River Basin, conductance readings as high as 2.6 millimhos were found in surface water at Interstate Highway 10 (see Histogram A). Even above the saltwater barrier near Lake Charles, several miles above Interstate Highway 10, conductance readings in the Calcasieu River reached 8.2-8.4 millimhos in 9.1 percent of the samples taken from 2 feet (0.6 meter) below the surface between August and November, 1972. More than one-third of the samples were above the freshwater limit (see Histogram D). In the Mermentau River, surface water approached the saline range in a small percentage of the samples at Lake Arthur (see Histogram E). Near Lafayette, five (1.4 percent) of the daily means calculated from continuous recordings 2 feet from the bottom in the Vermilion River were between 1.0 and 1.2 millimhos (see Histogram F).

In the Lower Atchafalaya River at Morgan City (Histogram G) the maximum conductance measured in bottom water during 1963 was 4.7 millimhos. Approximately 8 percent of the samples fell in the range of salty water. These high readings were

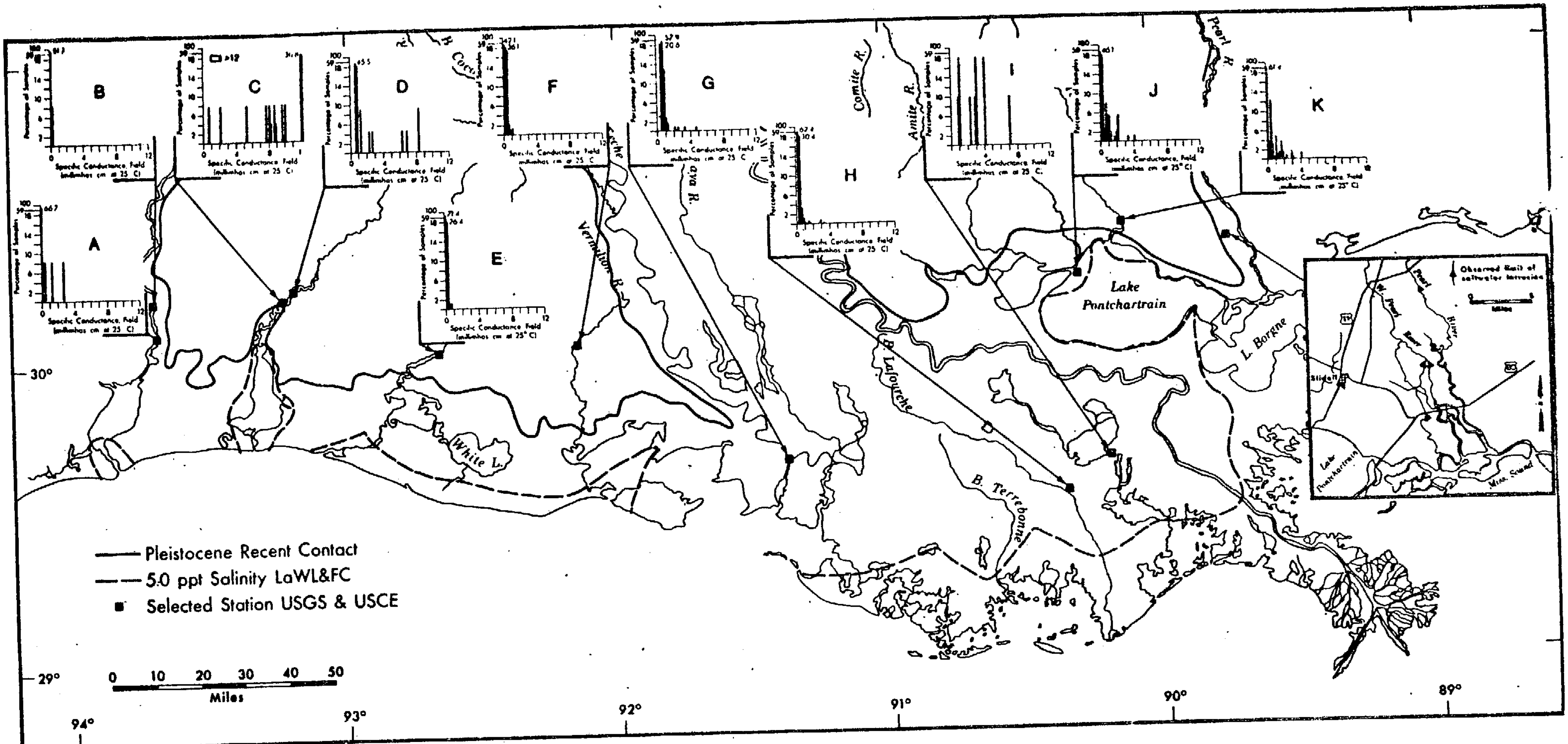
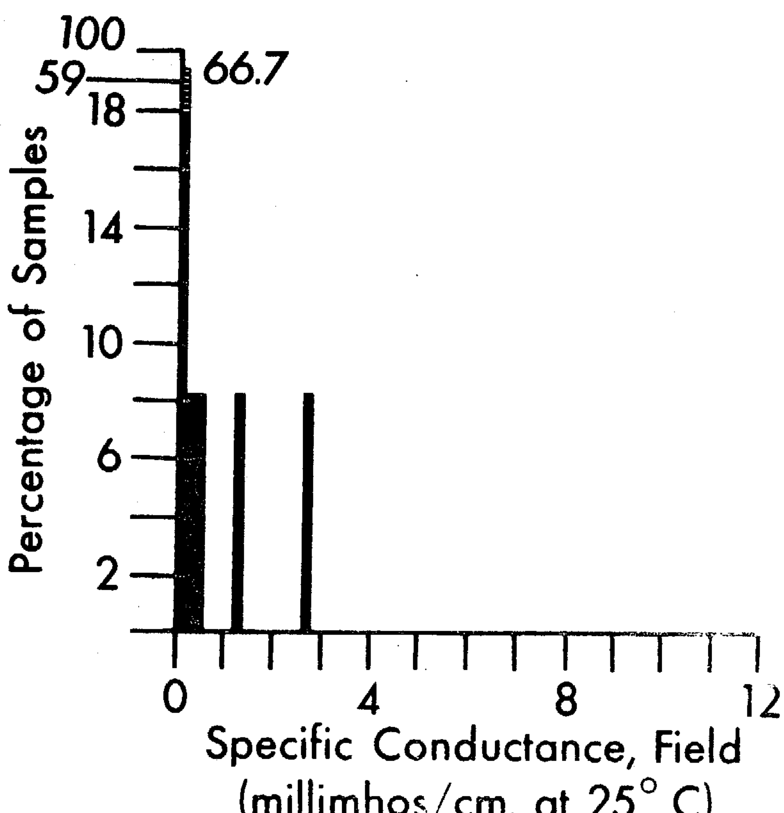


Figure 7. Salinity intrusion in Louisiana coastal areas. The dashed line represents the 5 ppt salinity line published by the Louisiana Wildlife and Fisheries Commission (Barrett, 1971). Also shown are histograms constructed from salinity records at 11 stations across the state (U.S. Geological Survey, 1969a, 1972; U.S. Army Corps of Engineers, 1963). Lack of data in the Pearl River Basin to support construction of a meaningful histogram made the type of presentation on the map insert more feasible (Cardwell et al., 1967). The histograms and the map insert are presented at full size at the end of Appendix 10.

HISTOGRAM A

SABINE RIVER BASIN

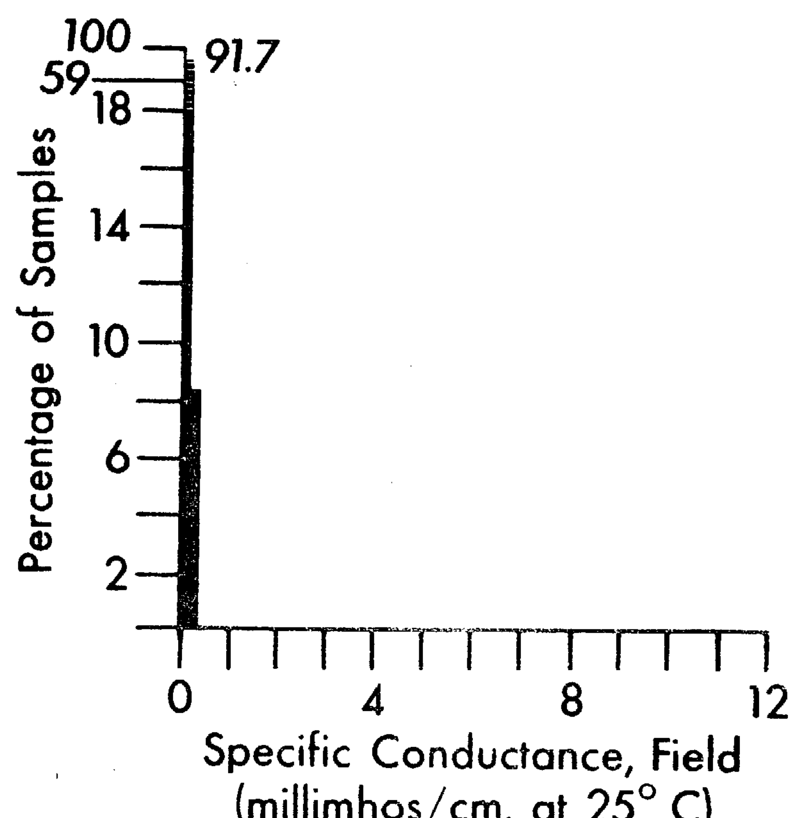
Station Location: I-10 at Orange, Texas
Station No.: 0501.0300
Latitude: 30° 07' 42"
Longitude: 93° 42' 00"
Depth: 1 ft. below surface
No. of Samples: 12
Period of Record: Oct. 2, 1972 - Sept. 10, 1973
Data Source: Texas Water Quality Board



HISTOGRAM B

SABINE RIVER BASIN

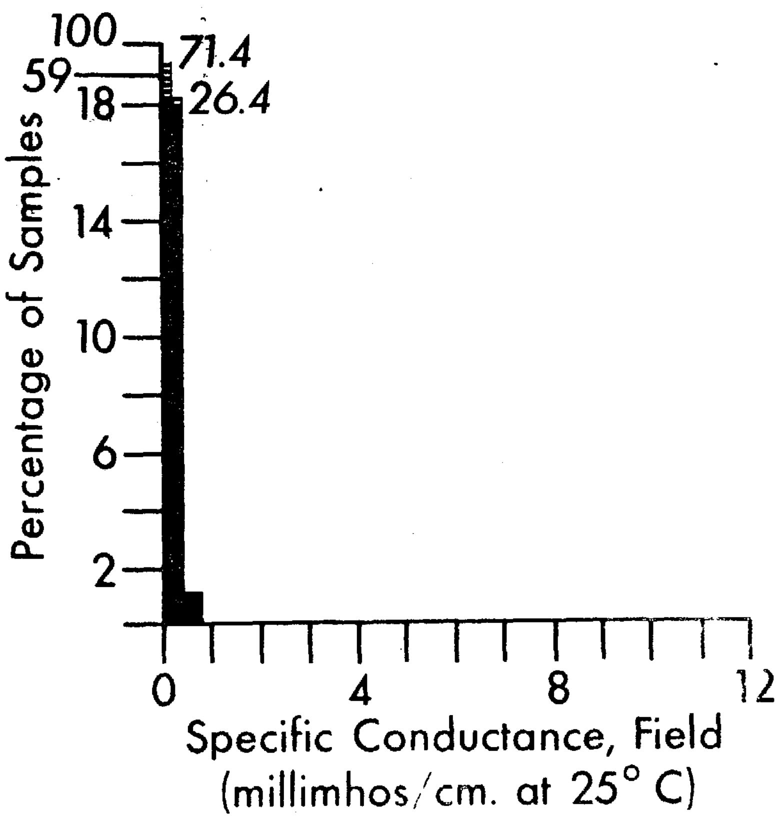
Station Location: Sabine River Authority pump station south of Deweyville, Texas
Station No.: 0502.0100
Latitude: 30° 13' 36"
Longitude: 93° 44' 15"
Depth: 1 ft. below surface
No. of Samples: 12
Period of Record: Oct. 11, 1972 - Sept. 12, 1973
Data Source: Texas Water Quality Board



HISTOGRAM E

MERMENTAU RIVER BASIN

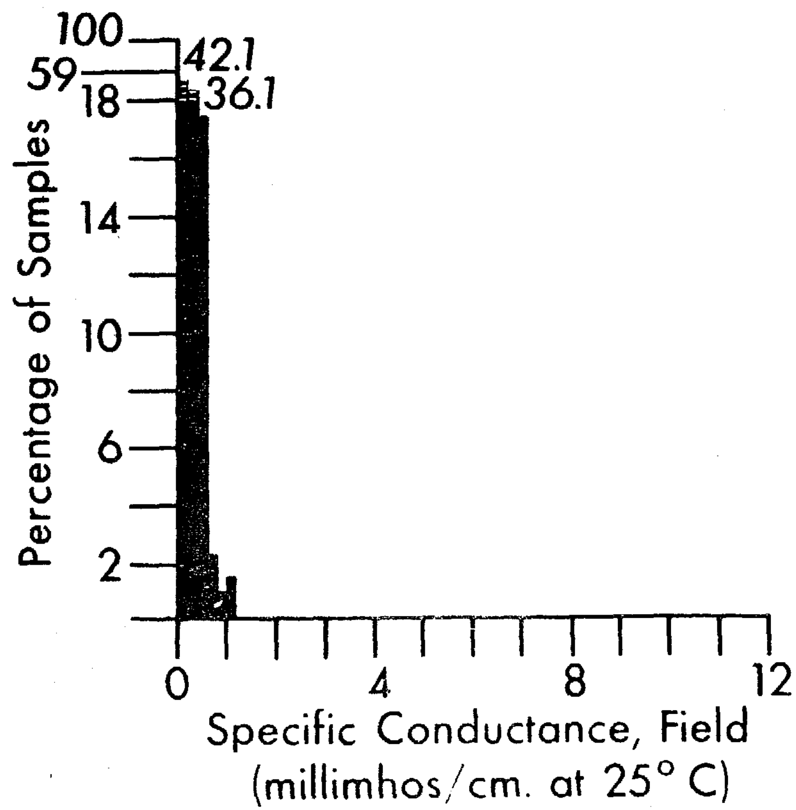
Station Location: Mermentau R. at Lake Arthur, La. Bridge on S.H. 14, 0.5 mi. east of Lake Arthur, Jefferson Davis Parish
Station No.: 8-124
Depth: 1-5 ft. below surface
No. of Samples: 364
Period of Record: Oct. 1, 1963 - Sept. 30, 1964
Data Source: U.S. Geological Survey, 1969b



HISTOGRAM F

VERMILION RIVER BASIN

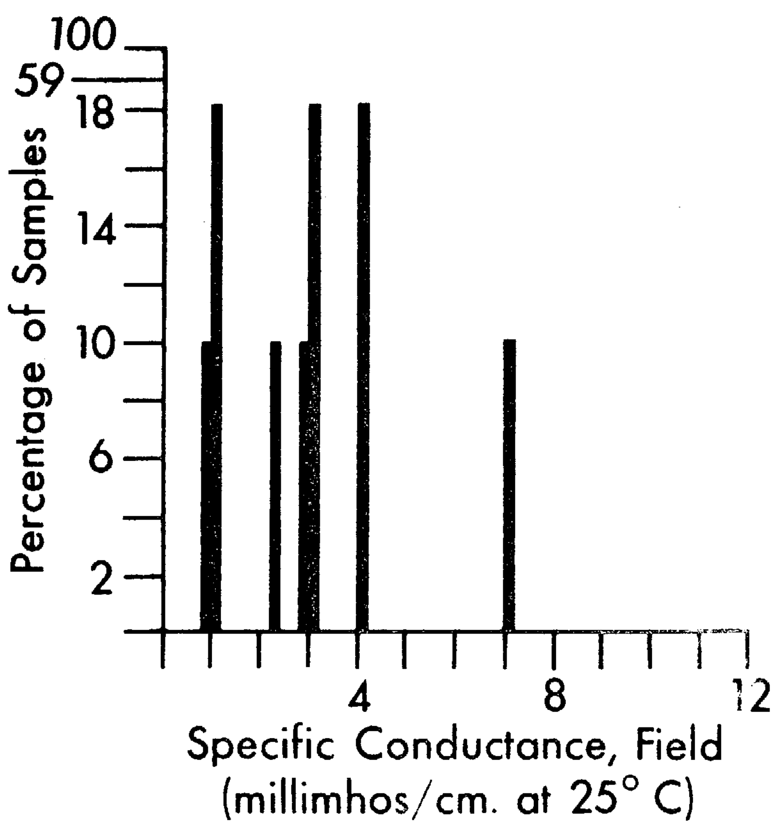
Station Location: Vermilion R. at S.H. 3073, near Lafayette, La.
Station No.: 07386935
Latitude: 30° 04' 40"
Longitude: 92° 03' 20"
Depth: 2 ft. from river bottom
No. of Samples: 363
Period of Record: Oct. 1, 1971 - Sept. 30, 1972
Data Source: U.S. Geological Survey, 1972



HISTOGRAM I

BARATARIA BASIN

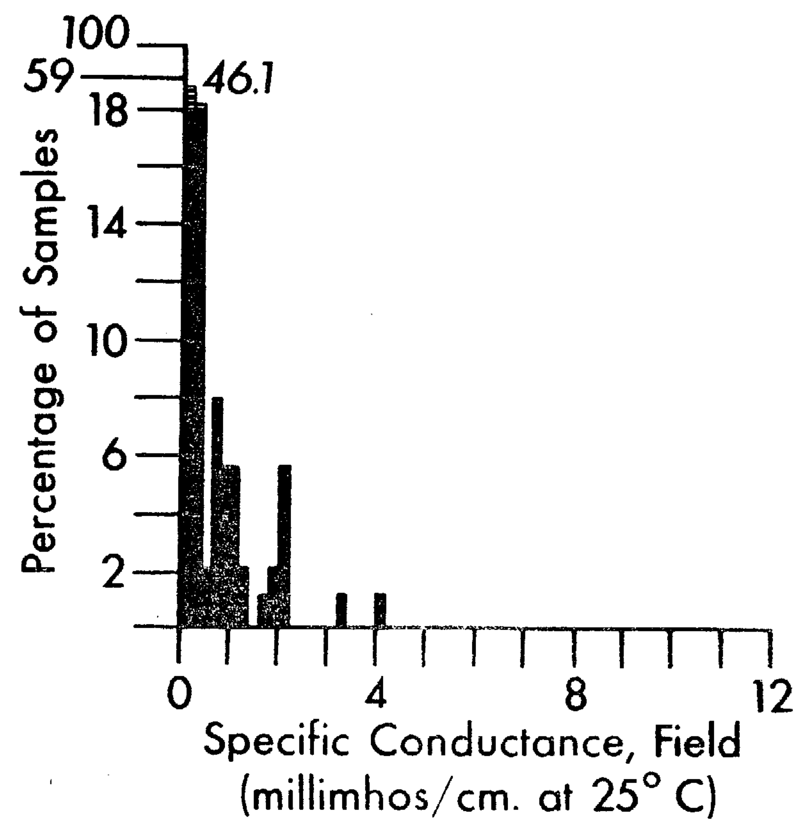
Station Location: GIWW at Bayou Perot (mi. 20)
Station No.: 81700
Latitude: 29° 41' 06"
Longitude: 90° 11' 19"
Depth: 2 ft. below surface
No. of Samples: 10
Period of Record: Aug. 2, 1973 - Dec. 19, 1973
Data Source: U.S. Army Corps of Engineers, unpublished data



HISTOGRAM J

PONTCHARTRAIN BASIN

Station Location: Lake Pontchartrain at Pass Manchac
Station No.: 85430
Latitude: 30° 17' 30"
Longitude: 90° 18' 00"
Depth: 2 ft. below surface
No. of Samples: 89
Period of Record: Jan. 24, 1973 - Dec. 5, 1973
Data Source: U.S. Army Corps of Engineers, unpublished data



appendix 11

Occurrence of Rangia cuneata (Brackish Water Clam)

Distribution of both living and dead brackish water clams across the state provides an insight into the interaction of marine waters with fresh water river basins and Gulf-connected lagoons, bays, and lakes. Although the clam can survive in fresh water once past the larval stage, its presence represents in general the extent of inland marine water intrusion.

This report includes occurrence of living clams and distribution of shucked clams as shell middens which represent former Indian habitation sites. Generally, clams were collected by the Indians from nearby waters and shucked at their living site. Although the sites extend back in time several hundred years, their distribution is not far removed from where living clams exist; this distribution correlates with salinity pulses which penetrate up the river basins. Both ranges of living clams and distribution of shell middens were mapped at the scale of 1:250,000 and then reduced to the scale of Figure 8. The shell middens are located on quadrangle maps and are on file for more detailed information.

Assistance from Robert Neuman and Jim Morgan of the Louisiana State University Museum of Geoscience is greatly appreciated. Both contributed significant information pertinent to this study.

OCCURRENCE OF LIVING CLAMS

Rangia cuneata (brackish water clam) is the dominant benthic animal in the 0 to 15 ppt salinity zone of estuaries (Cain, 1972; Hopkins et al., 1973). Hopkins et al. (1973) have studied the physical tolerances of this animal that adapt it particularly well to waters with fluctuating salinities. They found that adults can adjust quite well to salinities ranging from 0 to 30 ppt. This response could explain the presence of populations of this clam in virtually fresh water.

Reproduction is induced by a change in salinity, either up from zero or down from 15 ppt or above. Embryos and early larvae can survive only in salinities ranging from 2 ppt to 10-15 ppt. Therefore, a population of Rangia cuneata thriving in fresh water could only have been established during an island intrusion of brackish water. A population of adults may survive for 15 to 20 years in virtually fresh water but cannot reproduce.

The shaded areas on the map represent areas where populations have been systematically sampled. Only those areas useful in delineating the inland extent of saline waters were mapped. Surveys were conducted west of the Atchafalaya River by Hoese (1972) and in Lakes Pontchartrain and Maurepas by Tarver and Dugas (1973). Point records were gleaned from the literature and from personal interviews. No areas within the Atchafalaya Basin have been systematically sampled.

DISTRIBUTION OF INDIAN SHELL MIDDENS

Louisiana's extensive coastal wetlands and inland extending river basins were favored habitats for Indian occupation. These wetlands, endowed with a subtropical climate, provided an abundance of marine and fresh water animal and plant food. The relatively large number of Indian occupation sites attest to the availability of food, and site distribution shows a close correlation between their living sites and stream and shoreline changes through time. In this near sea level wetland setting the natural levees, beaches, cheniers (stranded beach ridges), and salt domes provided the high-ground sanctuaries on which Indians lived (Harris and Veatch, 1899; Collins, 1927; Kniffen, 1935, 1936, and 1938; McIntire, 1958).

Depending on their antiquity, the sites range from temporary hunting and fishing camps to more permanent villages. The sites which remain as evidence of former Indian occupation are divided into five types: shell middens, earth middens, shell mounds, earth mounds, and beach deposits.

Shell middens are by far the most numerous type in coastal Louisiana. They comprise the refuse heaps of shucked shells and other kitchen wastes discarded at the dwelling sites. Rangia cuneata makes up the widest spread and most extensive shell accumulations. This clam undoubtedly played an important role in the economy of the inhabitants. Depending on the regional location and the local environment of the

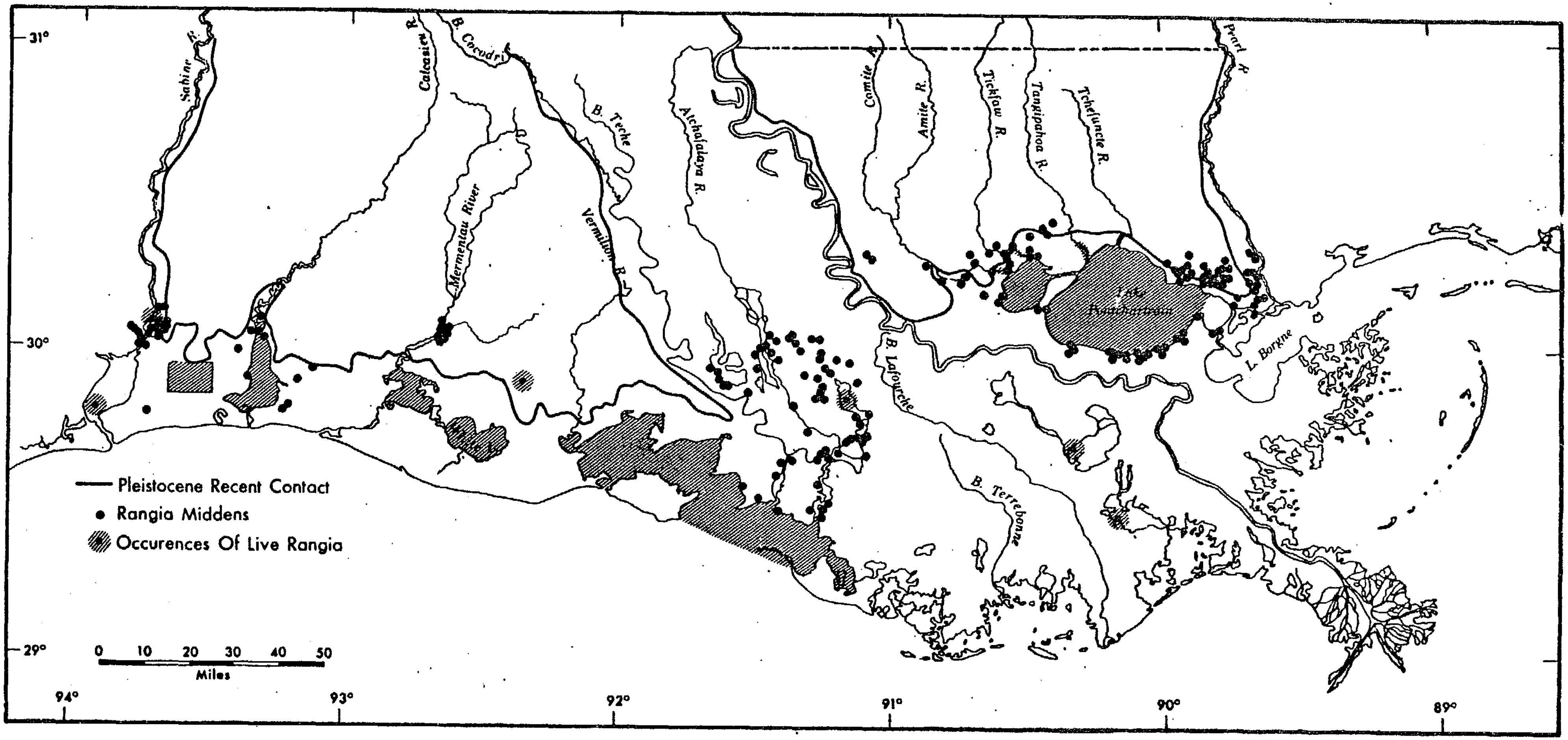


Figure 8. Distribution of viable populations of Rangia cuneata (brackish water clam) and historically viable populations as deduced from Indian midden deposits. Although adult Rangia can thrive in virtually fresh water, the early stages of its life history require salinities above 2 ppt. Therefore, upstream populations could only have become established during a period of brackish water intrusion.

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appendix 12

Inland Records of *Callinectes sapidus* (Blue Crab)

The blue crab is a species characteristic of the fluctuating estuaries. During the course of its life cycle, the blue crab lives in waters ranging from highly saline to virtually fresh (Gunter, 1938; Van Engel, 1958; Darnell, 1959; Jaworski, 1972). Mating takes place in relatively low salinity areas, after which females migrate to higher salinity areas while males remain in brackish areas or even migrate farther up rivers (Van Engel, 1958).

Adkins (1972) states that "the blue crab occupies almost all available habitat in coastal Louisiana from saline waters greater than 30 parts per thousand to fresh waters of the Atchafalaya River system." He further reports that in 1962 the blue crab fishery in the Atchafalaya Basin yielded 318,630 pounds (145,000 kilograms) of crabs. Gunter (1938) reports an occurrence of a subadult blue crab at Simmesport and states that they are regularly caught there during the summer. Local fishermen at Simmesport report that it is still possible to catch 10-15 crabs a day there, over 160 miles (250 kilometers) by water from the Gulf.

Published records of inland occurrences of blue crabs are sparse; therefore many of the records on the range map (Figure 9) come from interviews with local residents. These records are not scientifically documented, but since there is no species with which the blue crab can be confused, they are probably reliable.

This species, then, as a documented fresh water migrant that depends on the marine environment for reproduction, is important in demonstrating the interrelationship of coastal and inland waters.

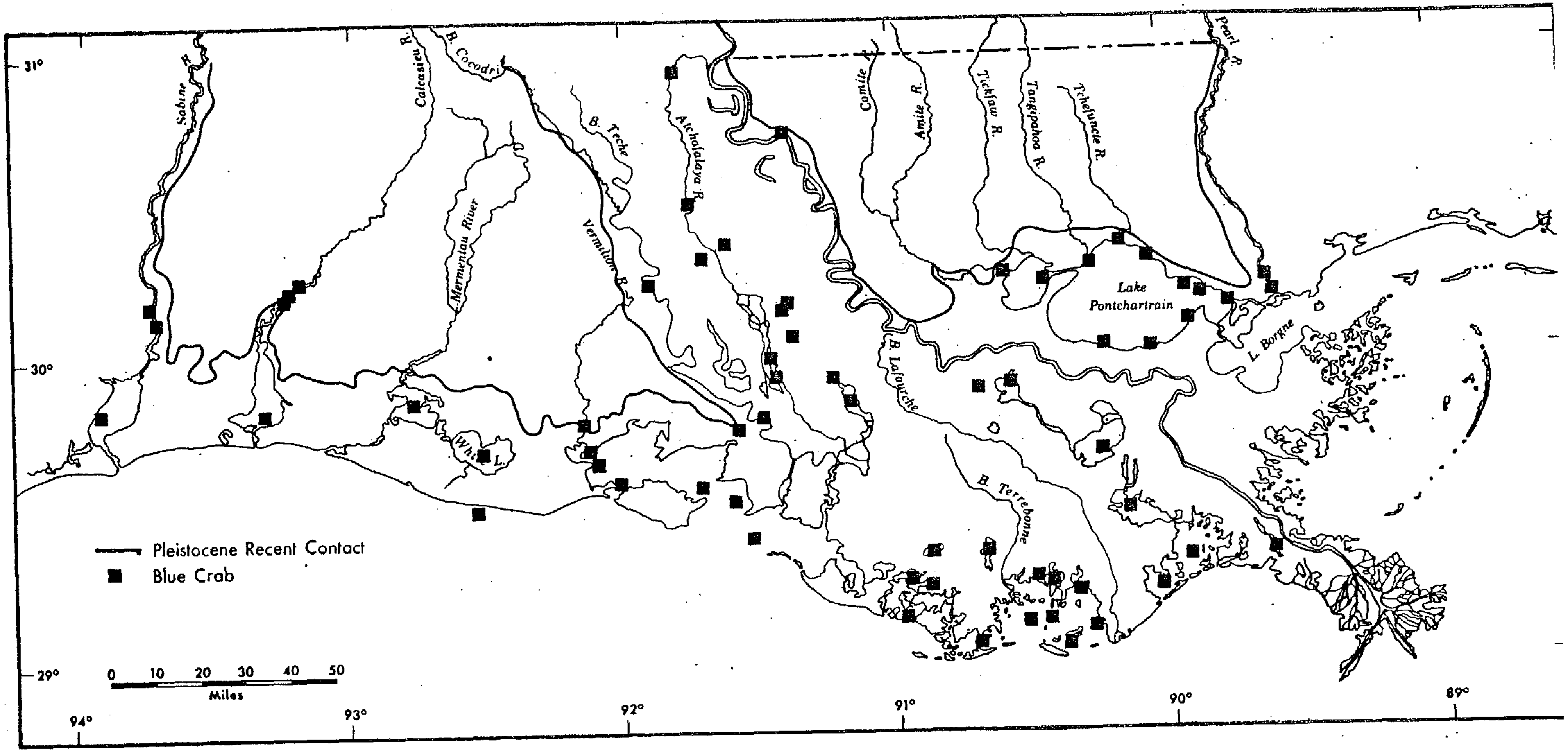

Figure 9. Inland records of Callinectes sapidus (blue crab) during historic times based on published records and interviews with local residents. Mating of this species takes place in relatively low salinity waters, after which females move to higher salinity areas. Males remain in brackish water areas after mating and may move further up rivers. Extreme inland records, therefore, probably represent males.

appendix 13

Inland Records of Marine Fish

(This study was compiled by John V. Conner, School of Forestry and Wildlife Management, La. State University, Baton Rouge.)

Invasion of fresh waters by marine fishes is a complex phenomenon (see Gunter, 1942, 1945a,b, and Pearse and Gunter, 1957 for reviews of the general subject; see Douglas, 1974, p. 400-401 for a recent discussion of occurrences in Louisiana). More than 60 species of fishes, ordinarily identified with marine or estuarine conditions, are known to occur in the fresh waters of Louisiana and other Gulf coastal states. Most have been recorded only from river mouths and/or marsh areas relatively near the Gulf of Mexico, but the 21 species listed in Table 2 have been observed quite far inland. This latter group might provide some indication of the inland extent of marine influence in Louisiana.

While there are multiple observations for most of these deeper invaders in more than one river system, the records are widely scattered, seldom formally published, and largely undocumented by preserved specimens. These factors confound attempts at a detailed analysis of the phenomenon, but the fragmentary data show, at least, that patterns of inland penetration vary considerably with respect to species involved, season, and drainage system.

The 21 species cited here may be grouped according to categories recognized by Massman (1954) for marine invaders of Virginia rivers:

1) Those found commonly in fresh water both as young and adults (bay anchovy) Atlantic needlefish, tidewater silverside, Gulf pipefish, striped mullet).

2) Those occurring commonly in fresh water only as young (ladyfish, Gulf menhaden, sand seatrout, spot, Atlantic croaker, hogchoker).

Table 2. Marine fishes known to occur in inland fresh waters of Louisiana (exclusive of anadromous forms).

FAMILY CARCHARHINIDAE - requiem sharks
- Carcharhinus leucas (Valenciennes)
  - bull shark

FAMILY DASYATIDAE - stingrays
- Dasyatis sabina (Lesueur)
  - Atlantic stingray

FAMILY ELOPIDAE - tarpons
- Elops saurus Linnaeus
  - ladyfish

FAMILY CLUPEIDAE - herrings
- Brevoortia patronus Goode
  - Gulf menhaden

FAMILY ENGRAULIDAE - anchovies
- Anchoa mitchilli (Valenciennes)
  - bay anchovy

FAMILY ARIIDAE - sea catfish
- Arius felis (Linnaeus)
  - sea catfish
- Bagre marinus (Mitchill)
  - gafftopsail catfish

FAMILY BELONIDAE - needlefishes
- Strongylura marina (Walbaum)
  - Atlantic needlefish

FAMILY ATHERINIDAE - silversides
- Membras martinica (Valenciennes)
  - rough silverside
- Memidia beryllina (Cope)
  - tidewater silverside*

FAMILY SYNGNATHIDAE - pipefishes, seahorses
- Syngnathus scovelli (Evermann and Kendall)
  - Gulf pipefish*

FAMILY CARANGIDAE - jacks and pompanos
- Caranx hippos (Linnaeus)
  - crevalle jack
- C. latus Agassiz
  - horse-eye jack

FAMILY SCIAENIDAE - drums
- Cynoscion arenarius Ginsburg
  - sand seatrout
- C. nebulosus (Cuvier)
  - spotted seatrout
- Leiostomus xanthurus Lacepede
  - spot
- Micropogon undulatus (Linnaeus)
  - Atlantic croaker

FAMILY MUGILIDAE - mullets
- Mugil cephalus Linnaeus
  - stripped mullet
- M. curema Valenciennes
  - white mullet

FAMILY BOTHIDAE - lefteye flounders
- Paralichthys lethostigma Jordan and Gilbert

FAMILY SOLEIDAE - soles
- Trinectes maculatus (Bloch and Schneider)
  - hogchoker

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*not truly diadromous (see text).

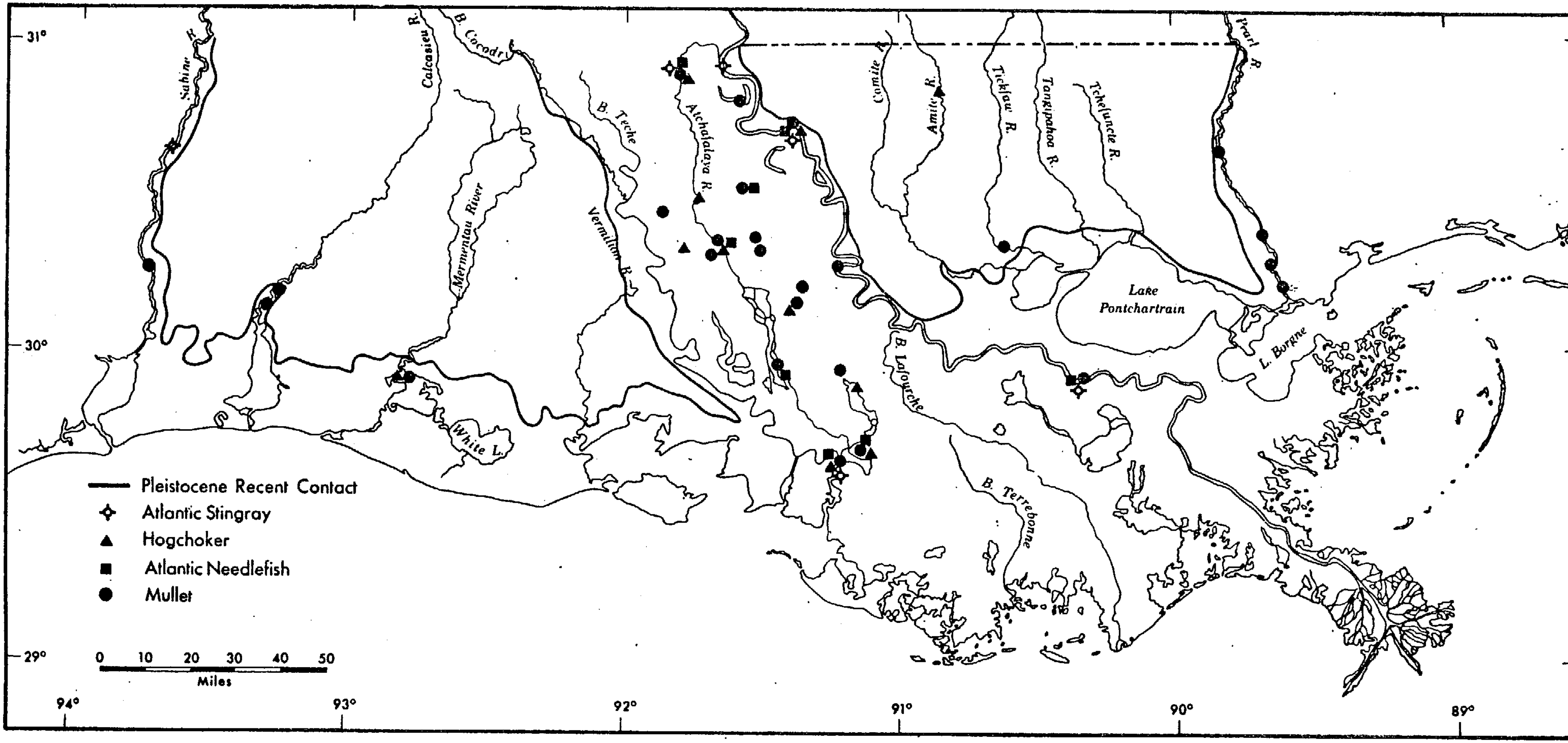

Figure 10. Inland records of Dasyatis sabina (Atlantic stingray), Trinectes maculatus (hogchoker), Strongylura marina (Atlantic needlefish), and Mugil sp. (mullet). These are four among a large number of fish species normally associated with marine environments that penetrate inland into freshwater areas. They may be grouped into three categories: 1) Commonly found in fresh water both as young and adults (Atlantic needlefish, mullet); 2) Commonly found in fresh water only as young (hogchoker); and 3) Rarely found in fresh water (Atlantic stingray).

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appendix 14

Reptile and Mammal Ranges

Each dot on a range map represents a locality from which a specimen of a particular species has been taken. Each record is carefully documented, the specimen having been examined and identified by an expert. From such maps a general idea of the actual range of a particular species can be obtained. There are inherent limitations to ecological interpretations of these maps. First, a single specimen from a particular area may represent a dispersing or migrating individual that was momentarily outside the habitat in which it breeds. Second, since each map shows a cumulative record over a number of years, one cannot infer fluctuations in range boundaries that might take place over a relatively short period of time. Third, a paucity of records from a particular area may represent one of two things: 1) low abundance of the species in the area, or 2) insufficient collecting effort in the area.

With these limitations in mind, a record of a species from a particular locality indicates that at least at some time the area provided the ecological requirements necessary for the survival of the species. Numerous records for a given area can add weight to this inference.

The border of a species' range can be of great ecological significance. It is at this point that a species encounters the limits of its adaptive tolerance. In many (probably most) species these limits are determined not by a single factor but by an array of factors, both physical and biological. Organisms act in this way as ecological integrators, and their occurrence or non-occurrence in a given area can be an indicator of community or ecosystem level interactions.

Life histories of most of the following species are poorly known for the state, but all respond either negatively or positively to wetland habitats.

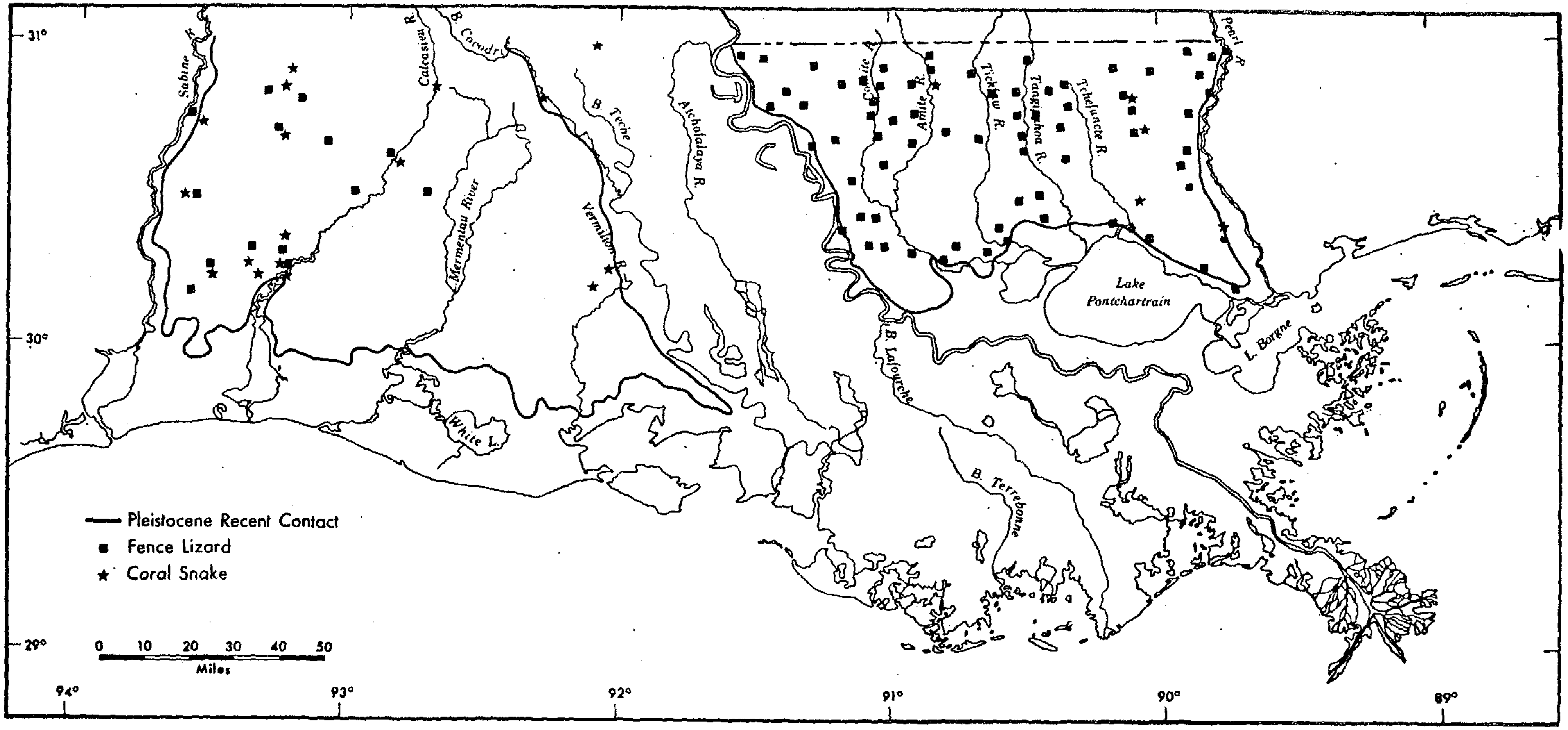

Figure 11. Distributions of Sceloporus undulatus (fence lizard) and Micrurus fulvius (coral snake)(from Dundee and Rossman, unpublished MS). Both of these species outline wetland areas by their absence. The fence lizard buries its eggs in the soil and thus is probably excluded from areas subject to flooding. There is no single aspect of coral snake life history that would preclude its existence in wetland areas; it probably responds to a constellation of factors.

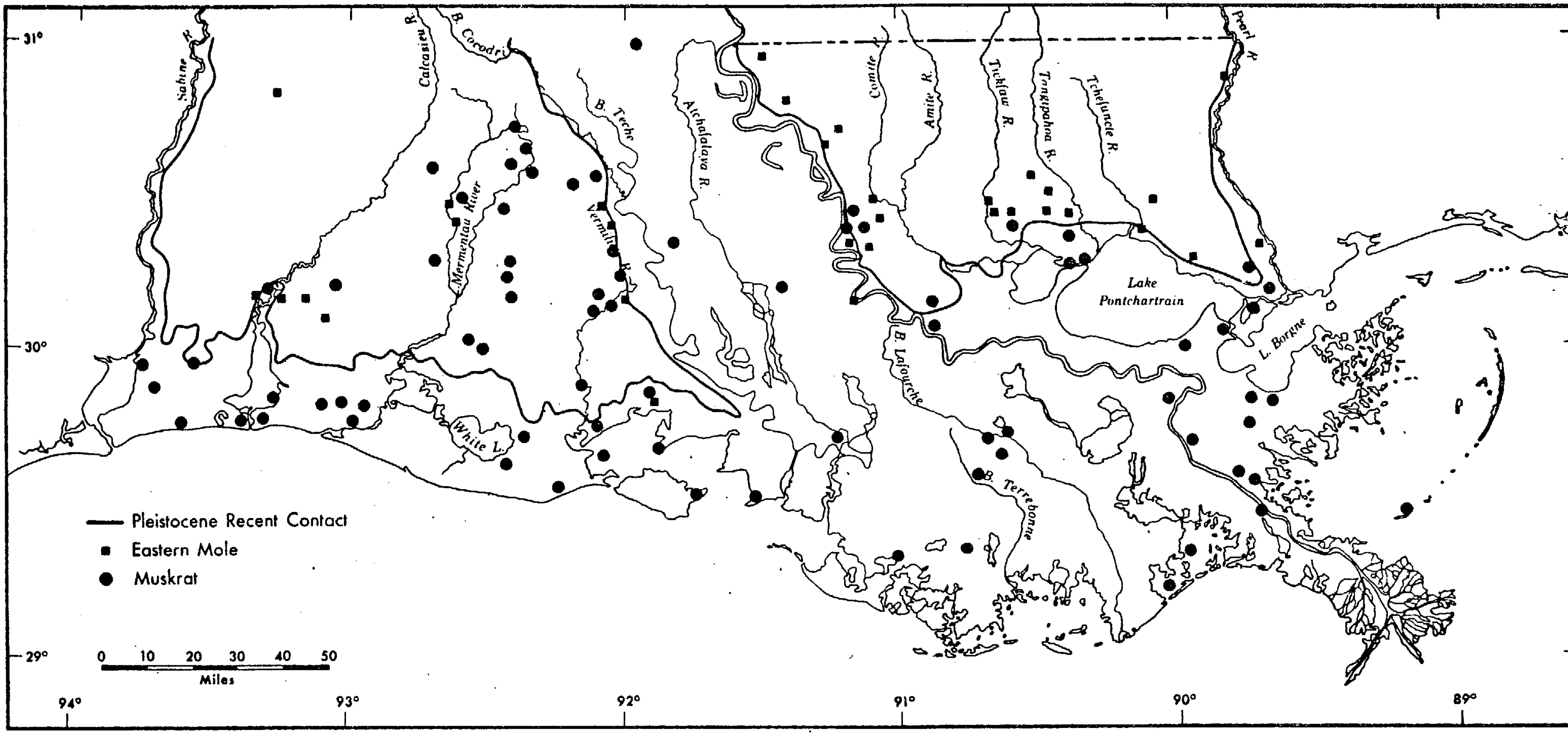

Figure 12. Distributions of Virginia stiatula (rough earth snake) and Storeria occipitomaculata (red-bellied snake) (from Dundee and Rossman, unpublished MS). Both of these small semi-fossorial species may avoid areas subject to flooding.

There are numerous records from the Florida Parishes, including three that appear to be from "forested wetlands." The species does not occur south of Lakes Pontchartrain and Maurepas, however, and the southernmost records generally correspond well with the wetland/upland interface. The southernmost records east of the Mississippi River are: St. Tammany Parish (12 mi N Slidell, 0.6 mi ENE Mandeville); Tangipahoa Parish (13 mi W Madisonville); Livingston Parish (3 mi S Holden); Ascension Parish (4 mi W Port Vincent); and East Baton Rouge Parish (Kleinpeter).

There are no records from the west bank of the Mississippi River or from the Atchafalaya Basin, except from Henderson (Keiser, personal communication). Records are exceedingly sparse west of the Atchafalaya Basin, the southernmost being: Iberia Parish (New Iberia, Avery Island); Jefferson Davis Parish (Jennings); and Calcasieu Parish (Lake Charles).

Storeria occipitomaculata (Red-Bellied Snake)

The red-bellied snake occurs in forested situations, usually with some hardwoods. It eats worms and slugs, possibly being especially adapted for the latter, and may be excluded from low areas by flooding (Rossman, personal communication).

The distribution pattern of the red-bellied snake is most useful in assessing wetland/non-wetland boundaries in the Florida Parishes, where records indicate an avoidance of any swamp forest. The southernmost records east of the Atchafalaya Basin are: St. Tammany Parish (Indian Village, 2 mi SSW Covington); Tangipahoa Parish (1 mi E Amite); St. Helena Parish (Greensburg); East Baton Rouge Parish (Baton Rouge); and Iberville Parish (2 mi S Plaquemine).

Dundee and Rossman (unpublished MS) show only three records west of the Atchafalaya Basin in southern Louisiana, and these are all from upland situations. The two southernmost are: Layafette Parish (Lafayette); and Allen Parish (4 mi W Oberlin).

MAMMALS

Studies were made on the distributions of species of mammals which might be relevant to Coastal Zone inland boundary delineation considerations. Distributions of 30 species of mammals were examined initially, and these were then narrowed to 5 species whose range boundaries show a coastwise orientation. With one exception (muskrat), these species reflect coastal influences by their absence in wetland situations.

The range maps (Figures 13 and 14) were drawn based on those of Lowery (1974). As with the reptiles, these species are poorly studied in the state with the exception of the muskrat (see O'Neil, 1949). Lowery (personal communication) and O'Neil (personal communication) have furnished some additional details on the life histories of these species.

Mammal range maps presented in the Corps of Engineers' Inventory of Basic Environmental Data were examined for possible relevance to the Coastal Zone boundary determination. The sources cited in this report are superseded by the publication of Lowery's The Mammals of Louisiana and Its Adjacent Waters (1974).

Scalopus aquaticus (Eastern Mole)

Lowery (1974) states that the eastern mole "does not occur regularly in coastal situations even on higher ground." Apparently any areas where the soil is inundated can act as effective barriers to dispersal of this species. Arlton (1936) conducted an ecological study of the eastern mole. In discussing its habitat requirements, specifically soil drainage, he states that they will colonize flood plains in dry periods but during floods they will drown. This, he says, can account for the general scarcity of moles in areas contiguous with flood plains.

In Louisiana there are abundant records for this species, but none from coastal marshes or wetland forests along the rivers of the state (including the entire Mississippi River flood plain). There is one record from Avery Island. This distribution supports the notion of a rather distinct biological discontinuity between upland forests and wetland forests.

Cryptotis parva (Least Shrew)

Lowery (1974) describes the habitat of the least shrew as "grassy fields or thickets along the edges of woodlands." Davis and Joeris (1945) state that "type of soil seems to be of minor importance in determining their distribution; shrews have been taken on both sandy and clayey soils, but nearly always in dense stands of grass." While not as strictly subterranean in habits as Scalopus aquaticus, the least shrew often builds its nests in burrows up to 8 inches under the surface (Davis and Joeris, 1945). Thus, it would probably be quite sensitive

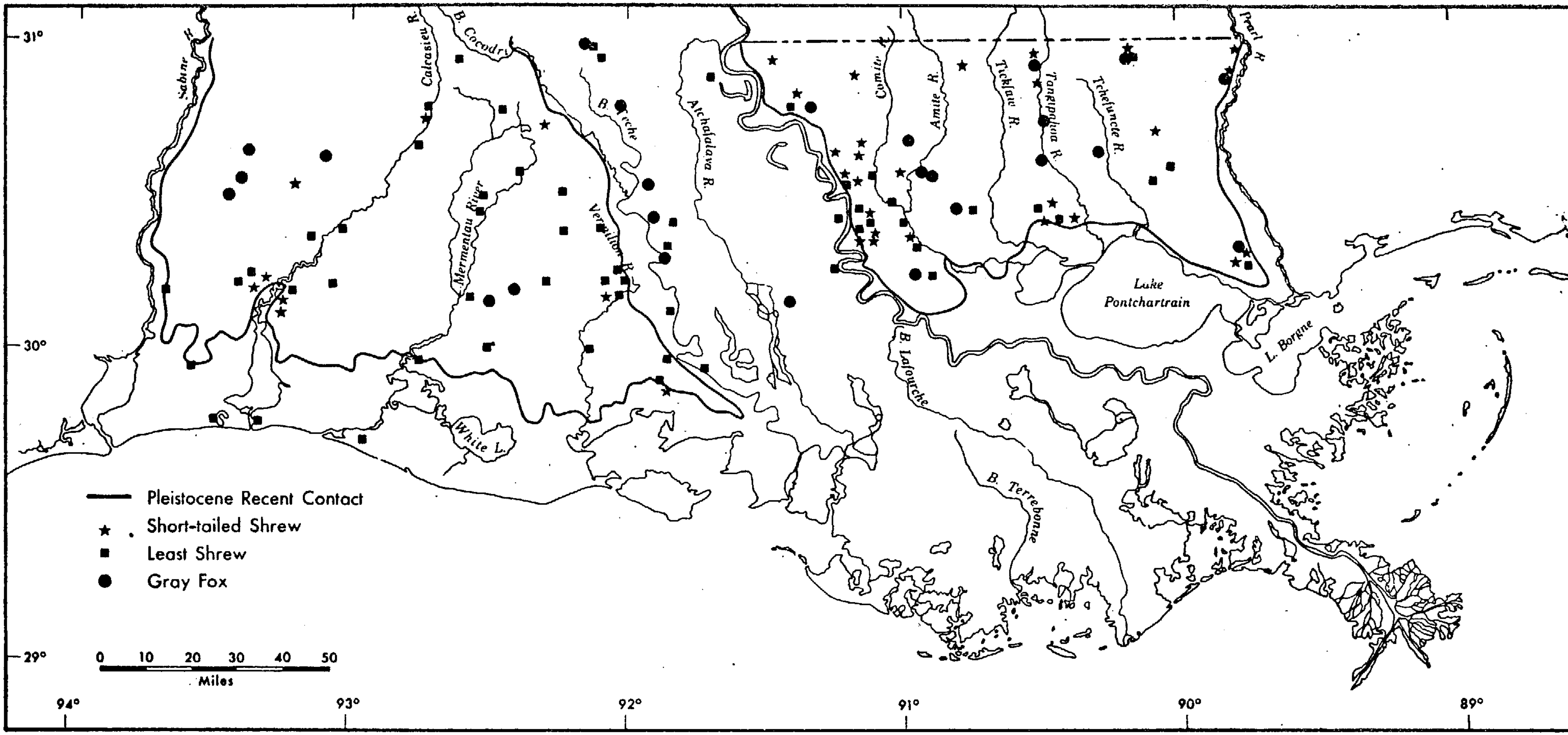

Figure 13. Distributions of Cryptotis parva (least shrew), Blarina brevicauda (short-tailed shrew), and Urocyon cinereoargenteus (gray fox)(from Lowery, 1974). These three species delineate coastal wetland areas by avoidance. The distributions of the two shrews follow the interface between upland areas and areas subject to periodic flooding; this may be correlated with their burrowing habits. The gray fox distribution may represent a response to more complex habitat characteristics.

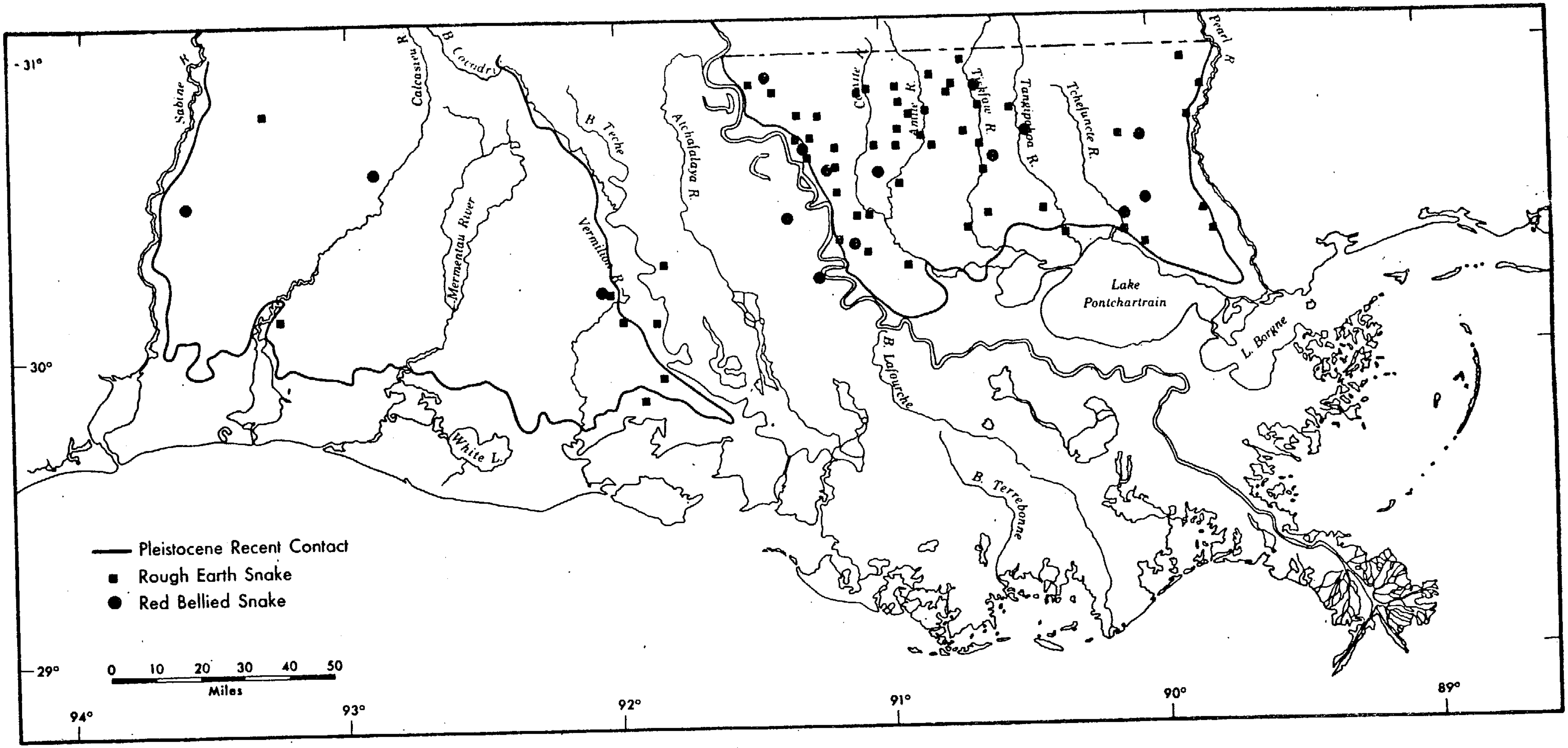

Figure 14. Distributions of Scalopus aquaticus (Eastern mole) and Ondatra zibethicus (muskrat) (from Lowery, 1974). The Eastern mole, a burrowing species, delineates the wetland/upland interface by its avoidance of areas subject to flooding. The muskrat's distribution outlines broadly the coastal wetlands, its northern extent possibly being correlated with the northern extent of rice farming (Ted O'Neil, personal communication).

Dundee, H. A., and D. A. Rossmann. In preparation. Amphibians and reptiles of Louisiana. Museum of Natural Science, La. State Univ., Baton Rouge.

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Lowery, G. H., Jr. 1974. The mammals of Louisiana and its adjacent waters. La. State Univ. Press, Baton Rouge. 565 pp.

_______. Personal communication. Museum of Natural Science, La. State Univ., Baton Rouge.

O'Neil, Ted. 1949. The muskrat in the Louisiana coastal marshes. La. Wildlife and Fisheries Comm., New Orleans. 152 pp.

_______. Personal Communication. La. Wildlife and Fisheries Comm., New Orleans.

Rossman, D. A. Personal Communication. Dept. of Zoology and Physiology, La. State Univ., Baton Rouge.

appendix 15

Coastal Hiatus of Spring Trans-Gulf Bird Migration

(This study was compiled by Sidney A. Gauthreaux, Jr., Dept. of Zoology, Clemson University, Clemson, S.C.)

Lowery (1945) confirmed Cooke's (1904) suggestion that many trans-Gulf migrants after crossing the Gulf of Mexico and reaching the Louisiana coastline fly some distance inland before alighting. He termed the coastal plain that was usually void of transients in fine weather the "coastal hiatus." Subsequently Lowery (1951) believed that the scarcity of records of transient migrants on the Louisiana coastal plain in fair weather was largely the result of a wide dispersion of birds in the dense cover that characterizes the region. Collected radar data support Lowery's more recent viewpoint regarding the landing areas of trans-Gulf migrants. On radar most of the echoes produced by migrants arriving from over the Gulf disappeared over the extensive forests 25 to 75 nautical miles (46 to 140 kilometers) north of the Louisiana coastline. Even in adverse weather some migrants continued inland until they reached the extensive inland forests, but on these occasions many migrants also landed closer to the coastline in the first available woodlands.

The data on landing areas of trans-Gulf migrants in southern Louisiana were taken from radar displays of the WSR-57 radars located at the National Weather Service stations in New Orleans and Lake Charles, Louisiana. More details on the characteristics of the radar and its ability to detect birds aloft can be found in Gauthreaux (1968, 1970, 1971). To gather information on the landing areas the radar was usually put on 100-nautical mile (185-kilometer) range with 0° antenna elevation, but on those few occasions when migrants were going well inland before landing, the radar was set at 250-nautical mile (460-kilometer) range. I have recorded the landing areas in terms of a latitude and longitude grid. The data are plotted every 0.5 degree of

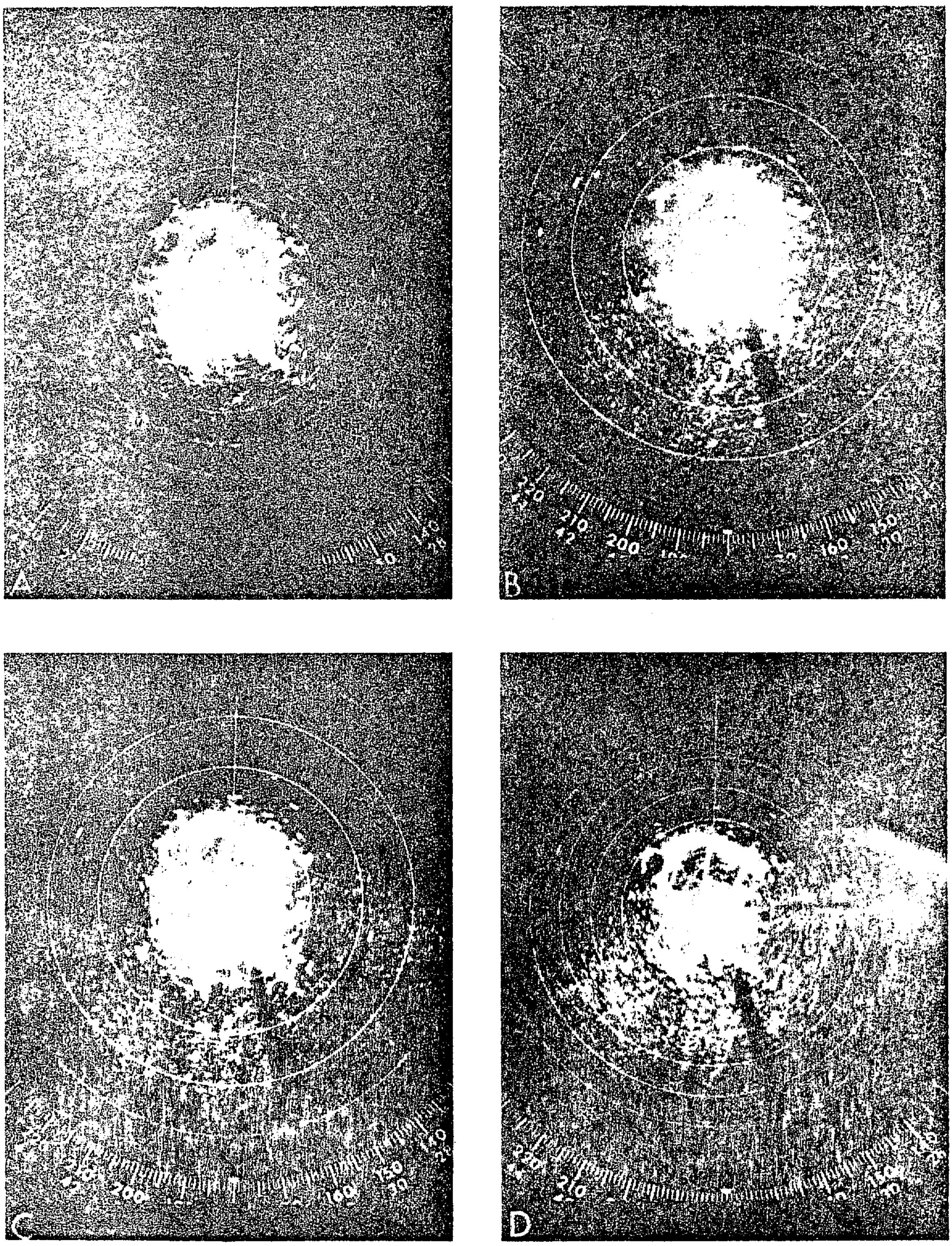

Figure 15. Radar photographs taken at the New Orleans station on April 23, 1967, showing the arrival of a trans-Gulf bird migration in southeastern Louisiana. Antenna elevation: 0 degrees. 100 nautical mile range. (A) 06:10 CST; (B) 06:20 CST; (C) 06:30 CST; (D) 07:30 CST.

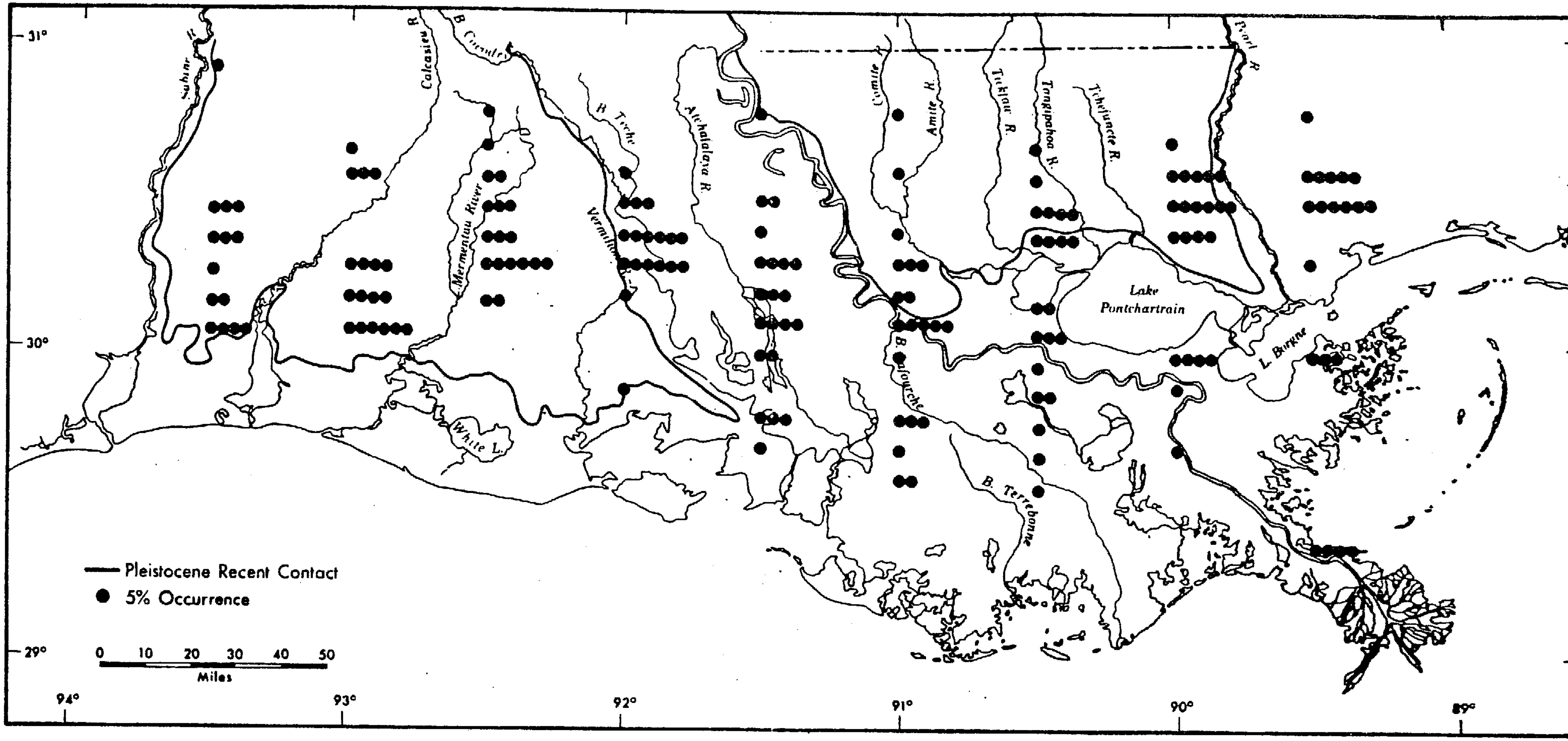

Figure 17. Distribution of major landing areas of spring trans-Gulf migrations of birds in southern Louisiana (from Gauthreaux, 1971). The bulk of daily trans-Gulf flights of a variety of songbird species regularly overfly the coastal marshes and alight in inland forests. This behavior has been quantified for 95 trans-Gulf flights using weather radar at New Orleans and Lake Charles. Each dot represents approximately 5% occurrence of landing in a particular area. The rows of dots are arranged along lines that are tenths of a degree of latitude and extend to the right of the point of longitude intercept (consult Table 3 for exact values).